v5.0.14.0 CO Validation Update

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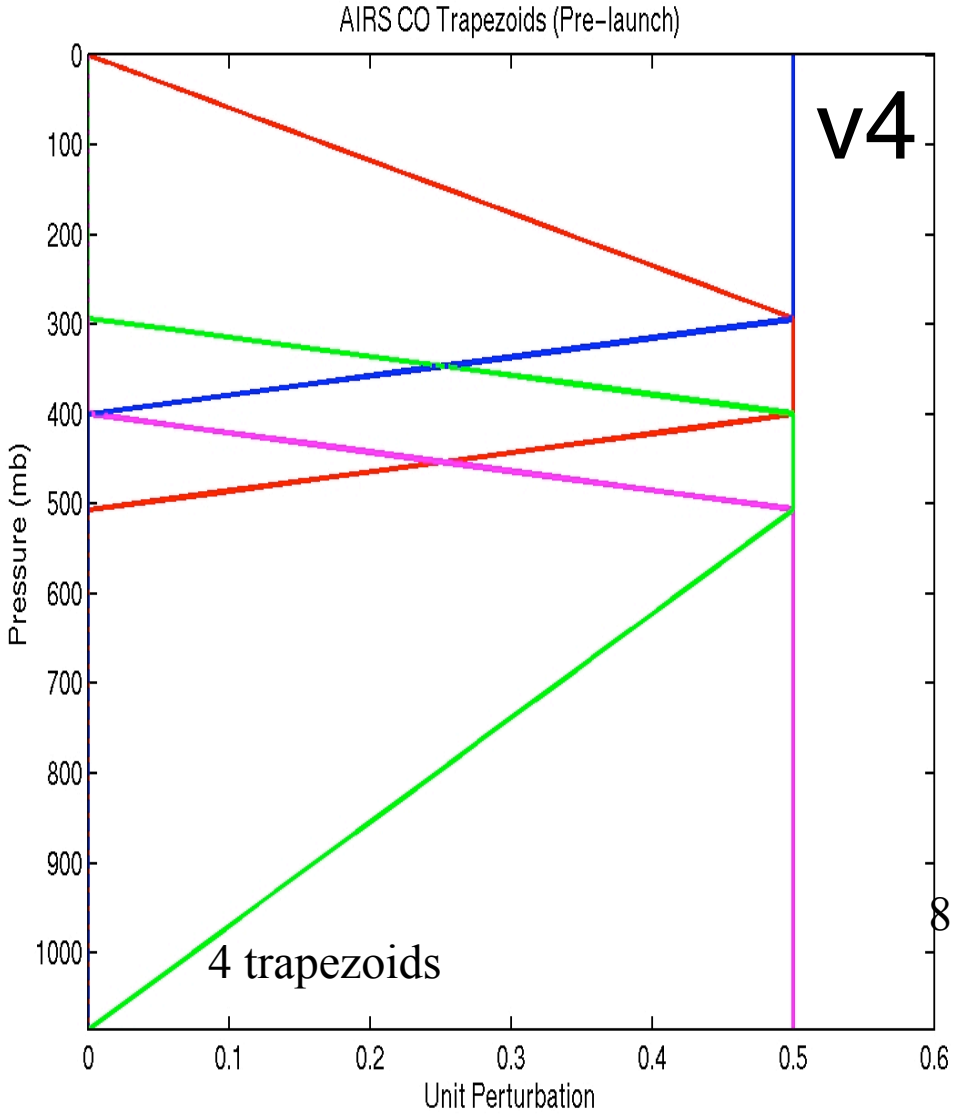
Supported by NASA AIRS, EOS Validation, and Tropospheric Chemistry Programs

Thanks to the entire AIRS Team and NDACC Colleagues

SUMMARY

- v5 improved over v4!
  - v4: only 500 mb validatable: 8% high ± 5%
  - v5: 350, 500, 700, 850 mb: 2-10% high ± 5%
- AIRS 500 mb vs. DC-8 in situ
  - INTEX: AIRS 5-10% high bias ± 5%
- AIRS total column vs. ground-based FTIR
  - AIRS 10% high bias for DOF > 0.8
- AIRS near surface vs. AERI PBL
  - AIRS bias near 0% but large σ
- AIRS near surface vs. surface in situ
  - AIRS 30% low bias and large σ

AIRS CO Trapezoids



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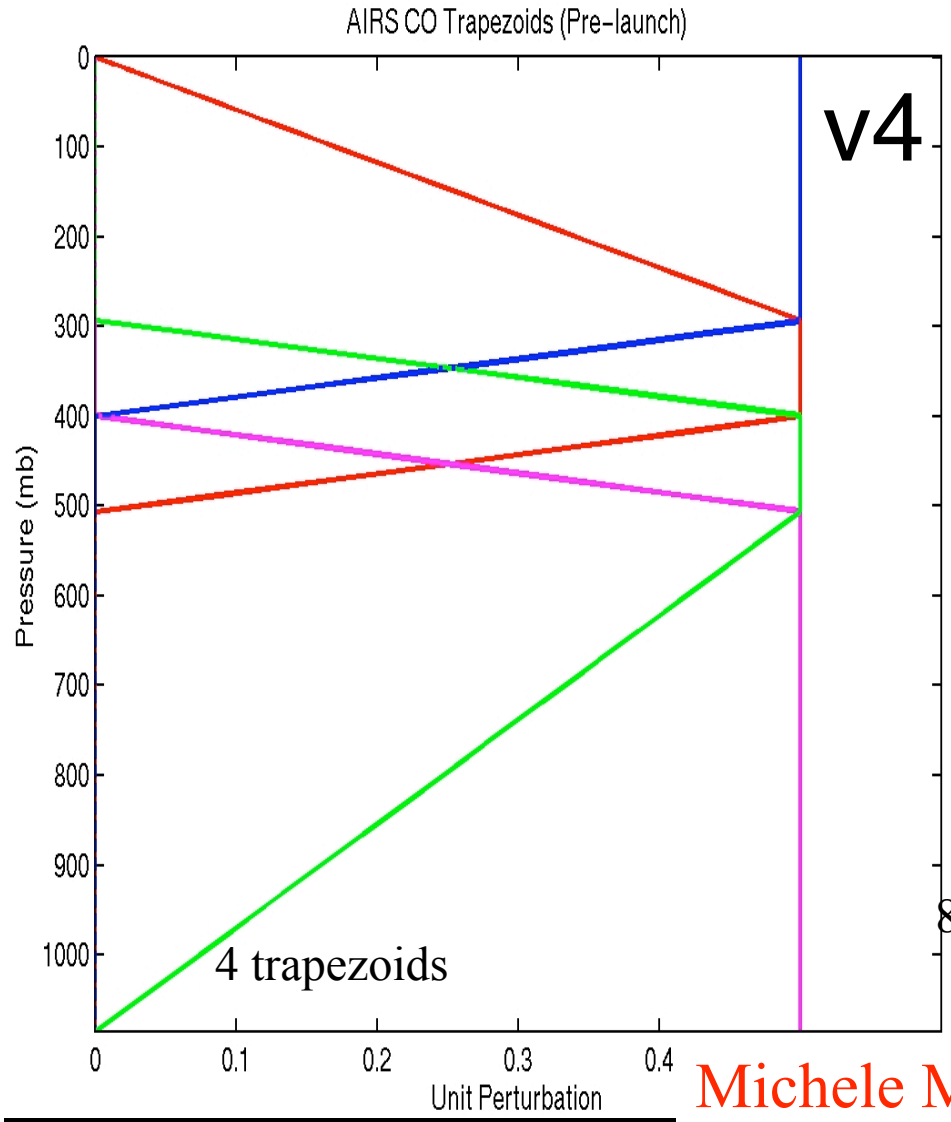
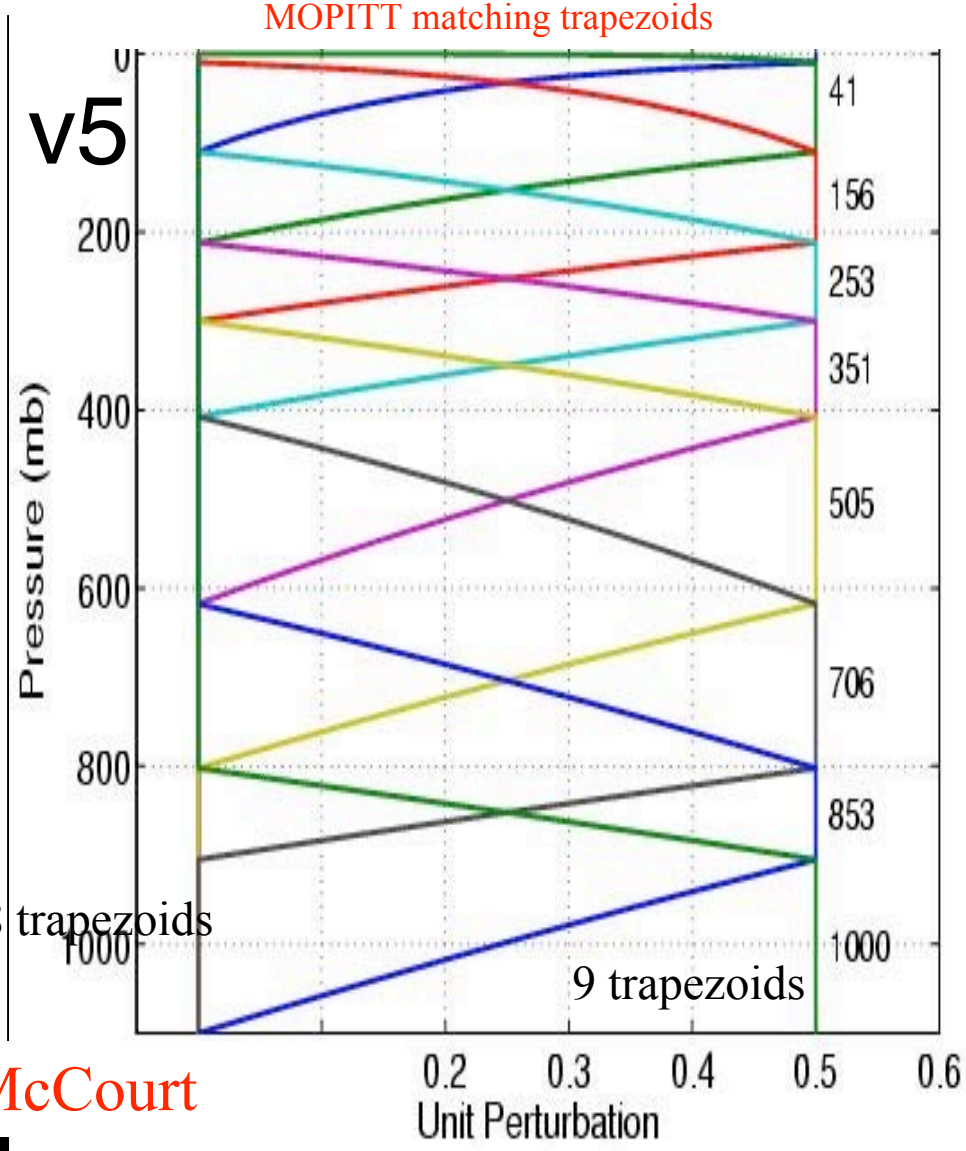
AIRS CO Trapezoids





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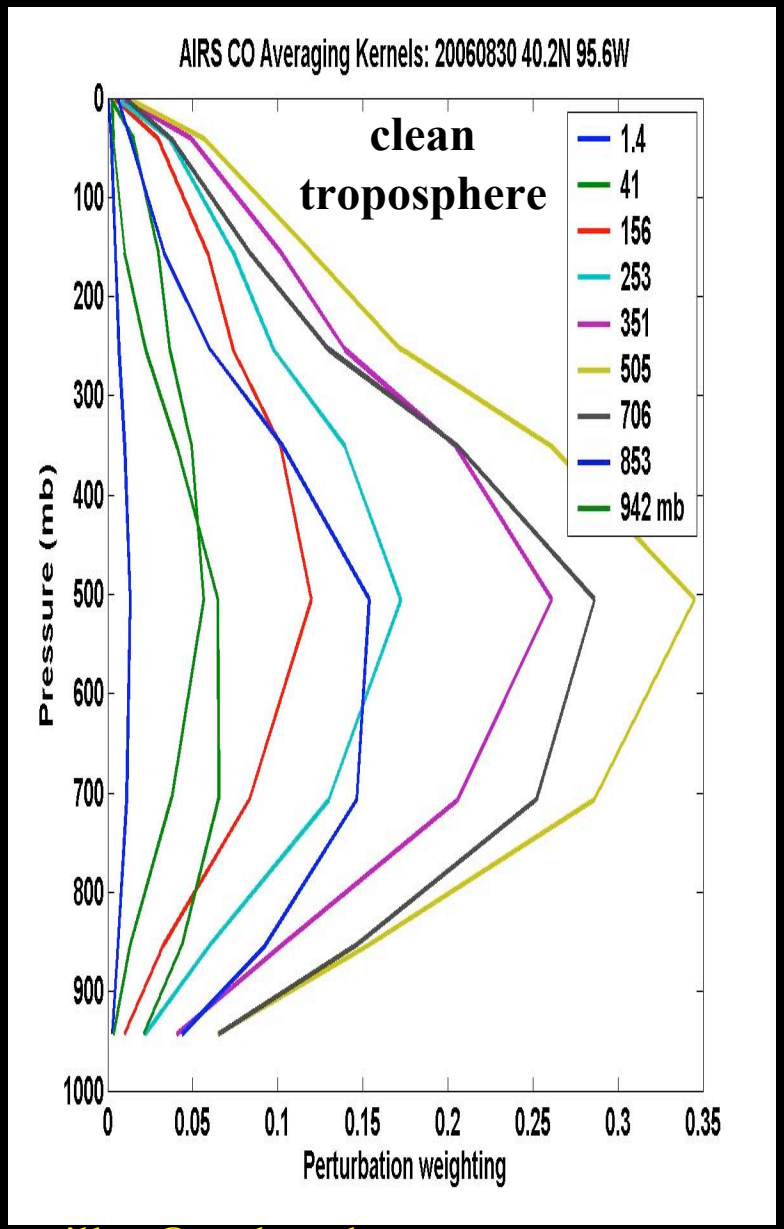
AIRS CO Averaging Kernels



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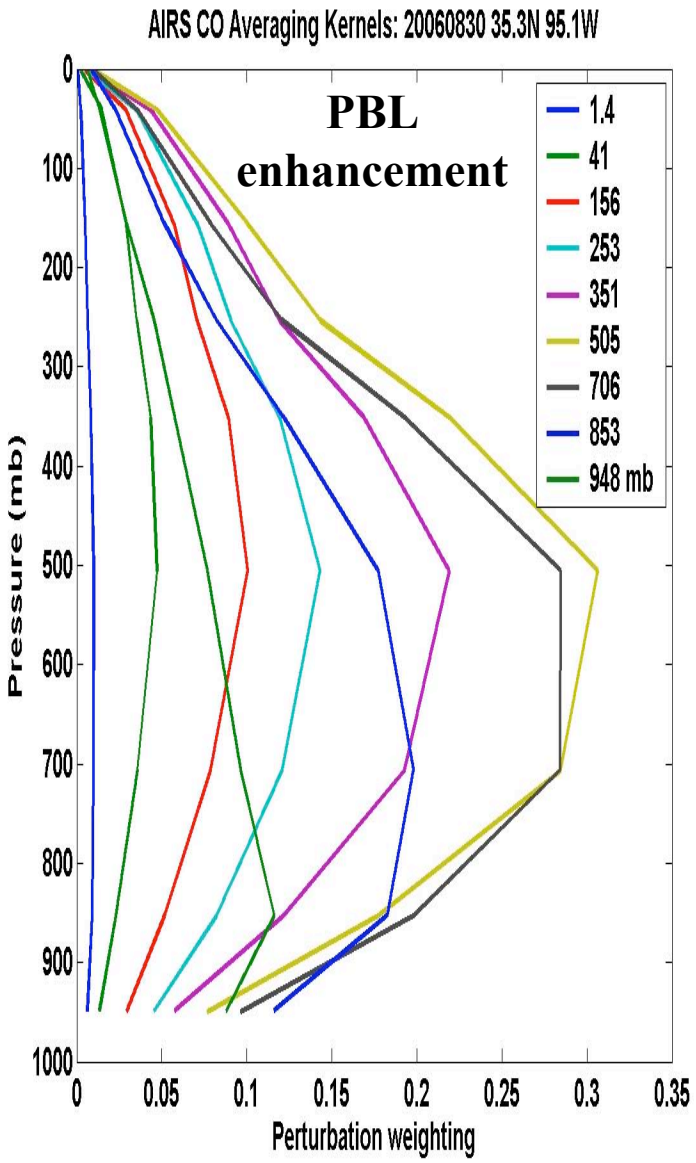
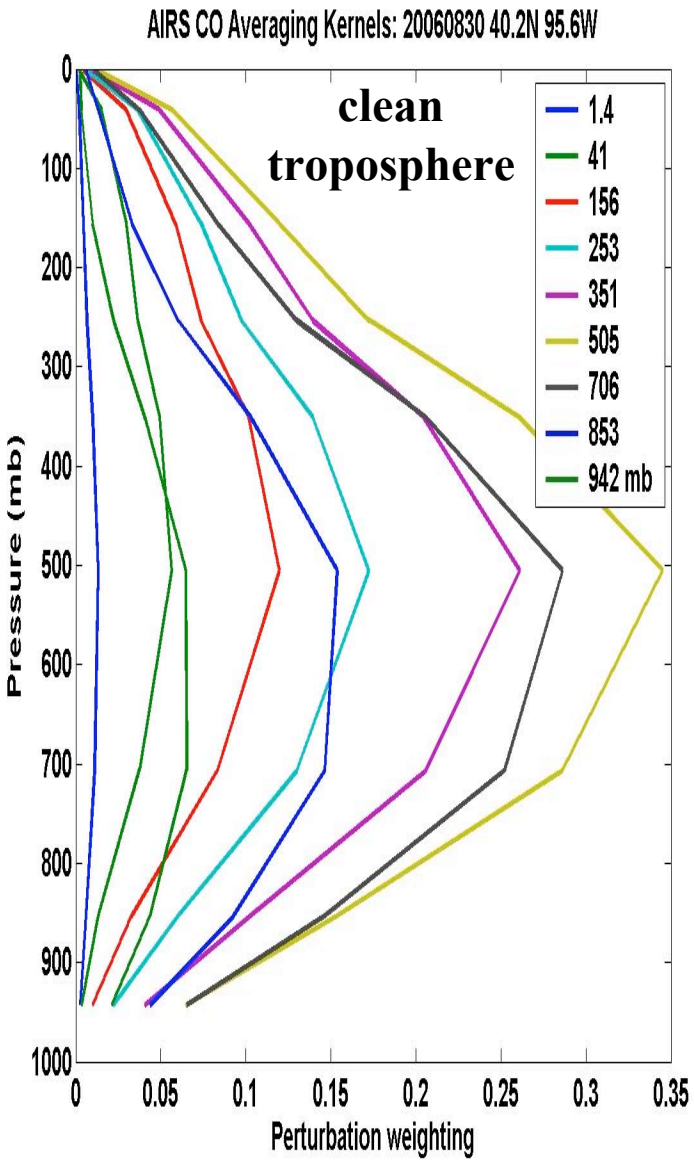
AIRS CO Averaging Kernels





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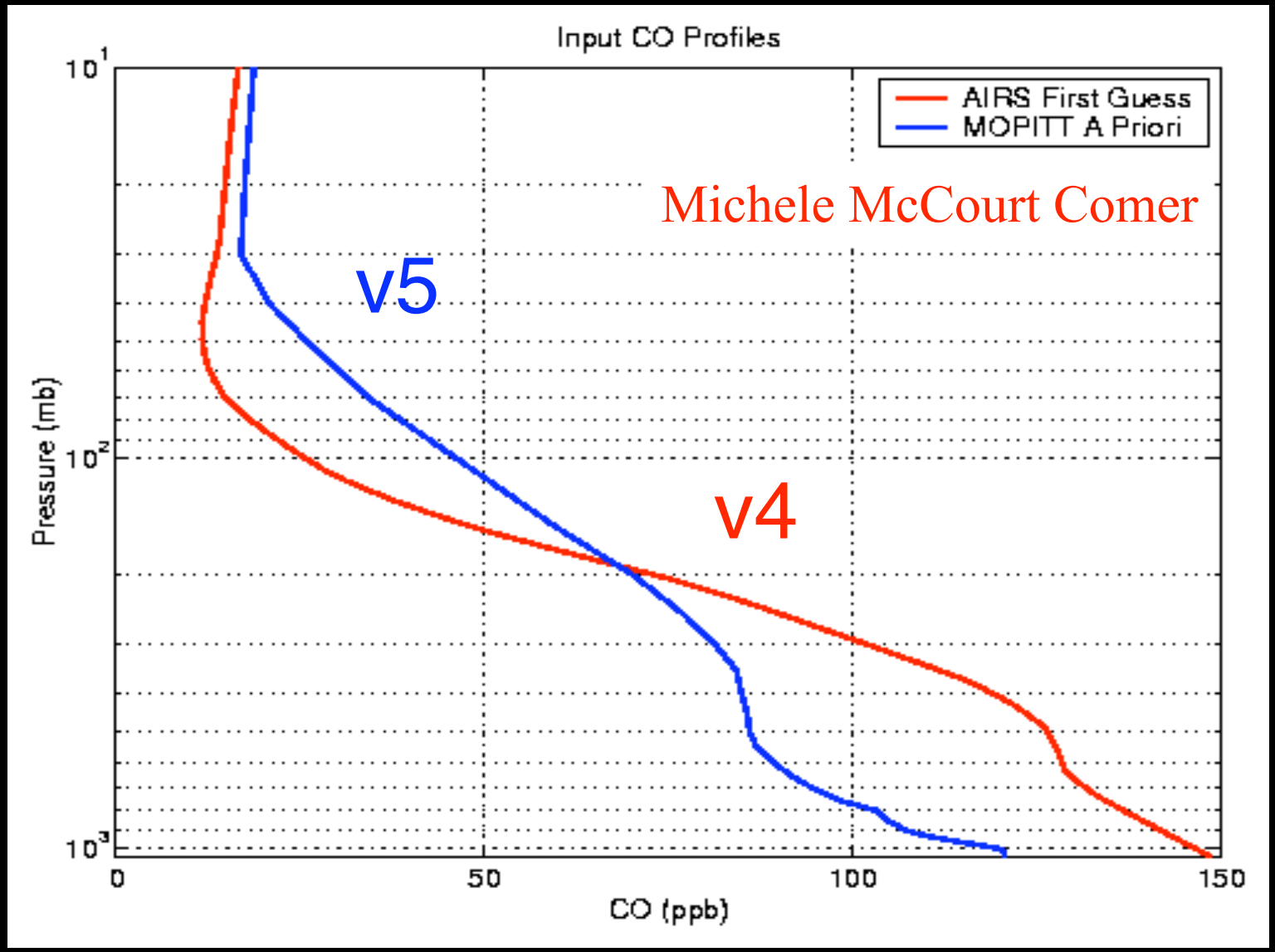
AIRS CO First Guess Profile



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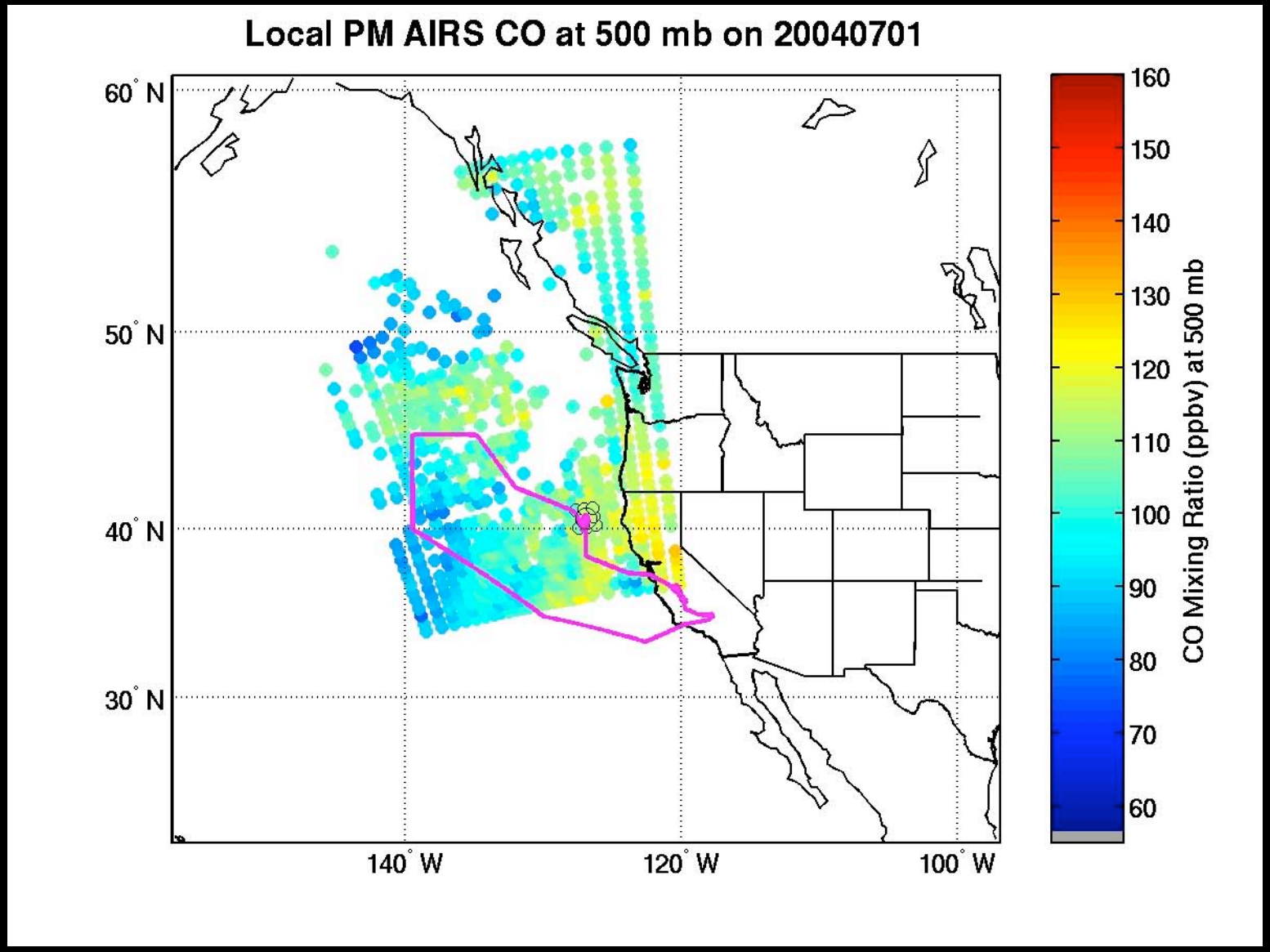
INTEX-A

- Intercontinental transport of US pollution to Europe
  - NASA DC-8: US west coast to cent. Atlantic
  - July-August 2004
- NASA DC-8, NOAA P-3, UK BAe146, and German Falcon
- 16 DC-8 spiral validation profiles for AIRS and MOPITT
  - 13 DC-8 profiles good for AIRS CO validation
- AIRS 500 mb CO: 6% high bias ± 5%

INTEX-A



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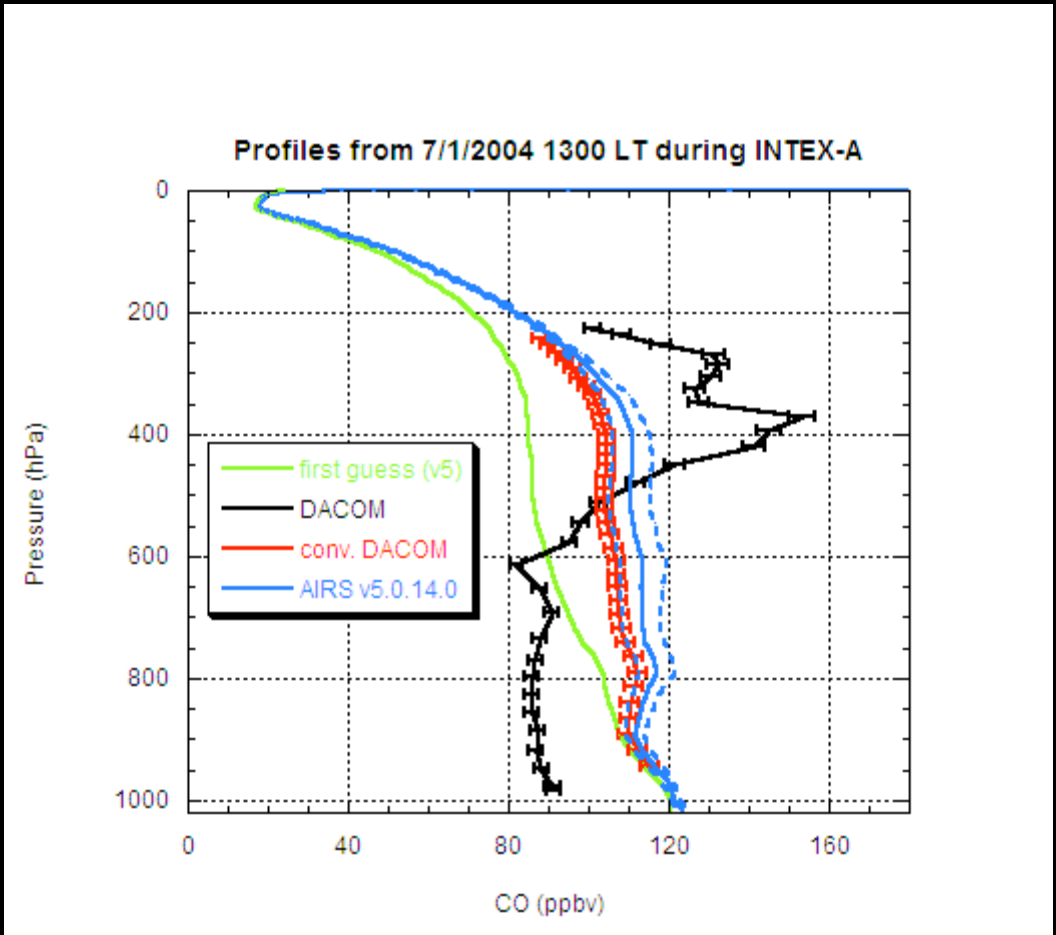
INTEX-A: AIRS vs. DC-8 in situ



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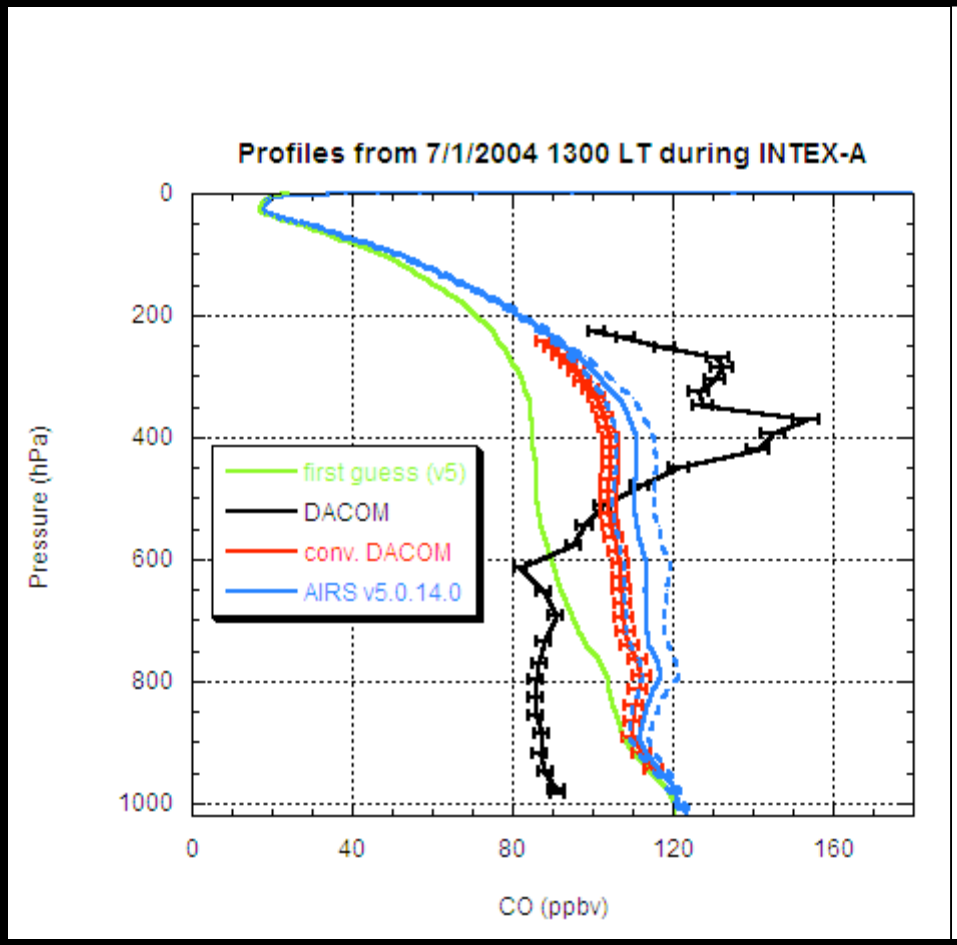

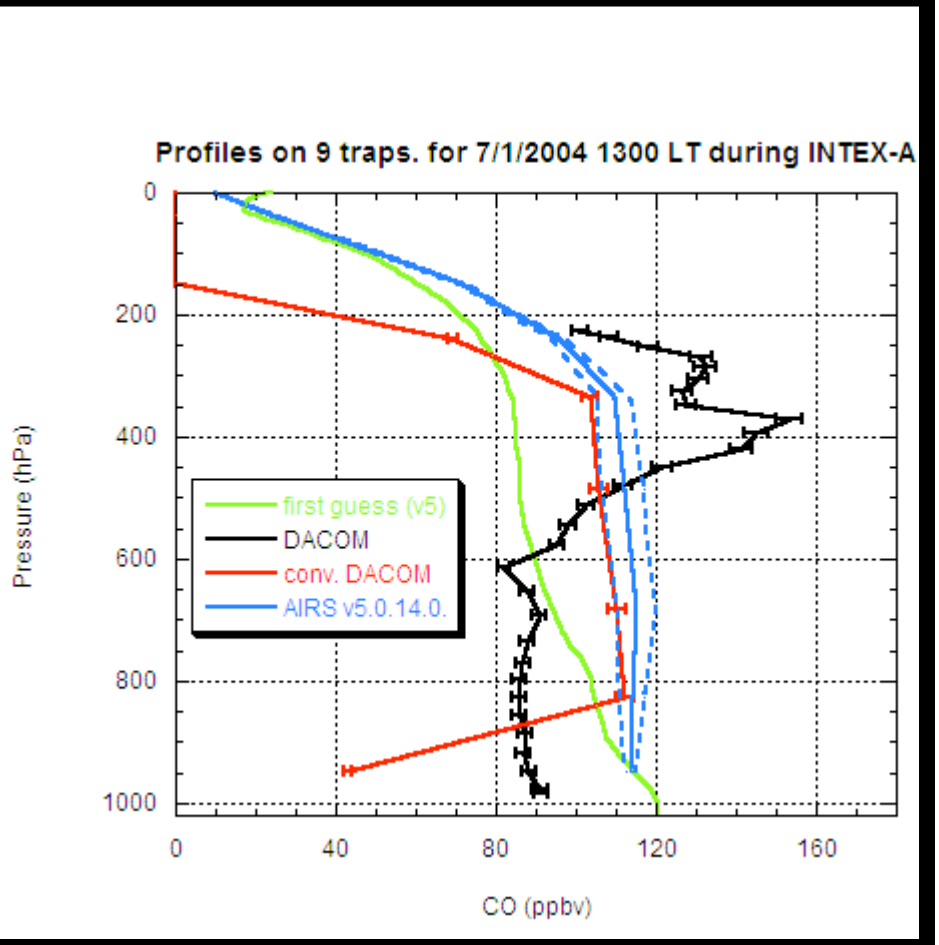

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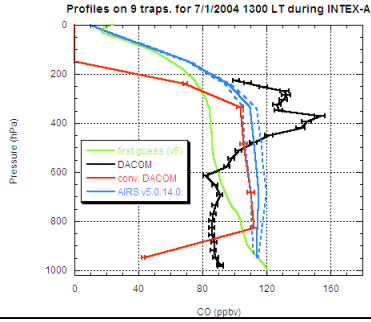
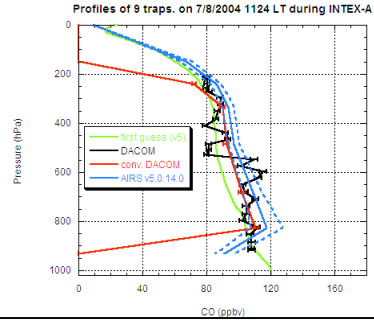
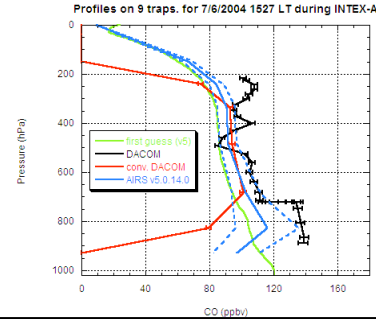
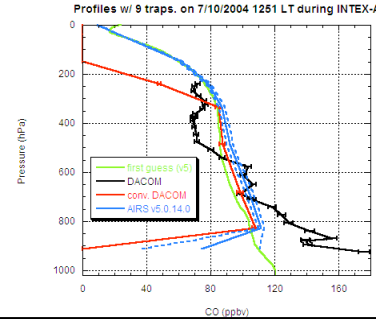
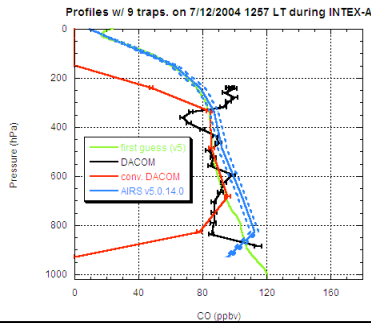
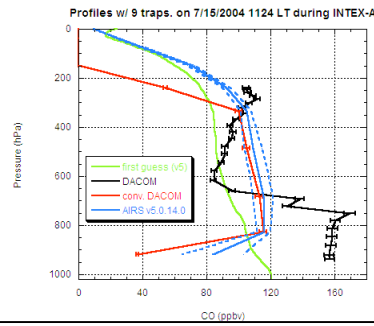


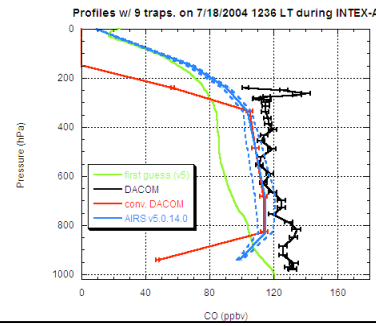


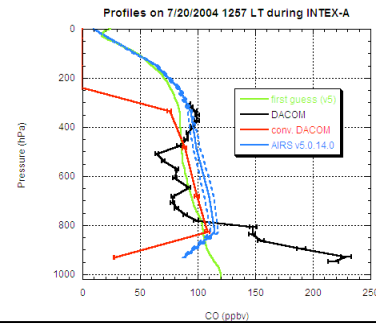


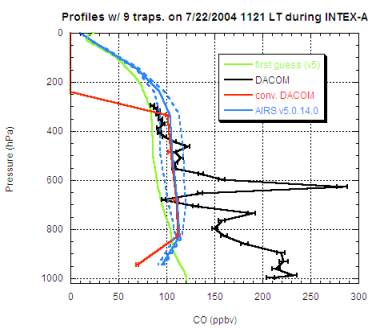


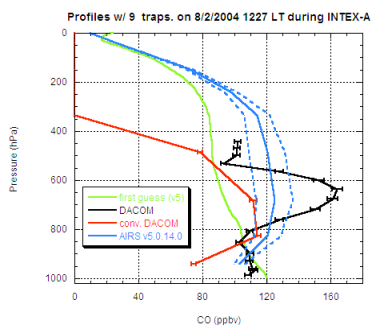


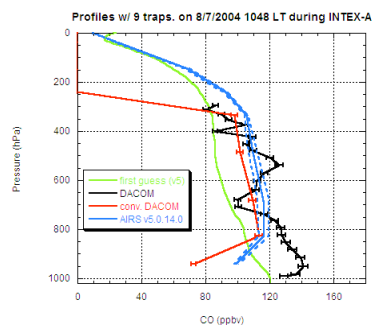


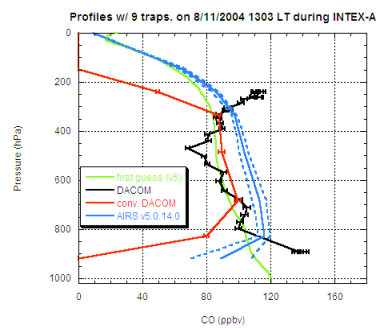


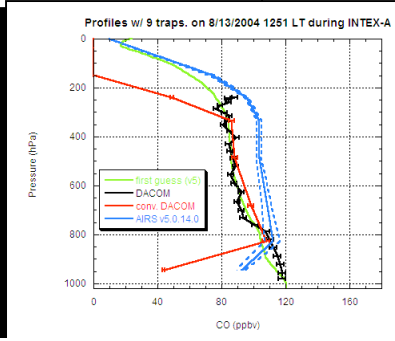








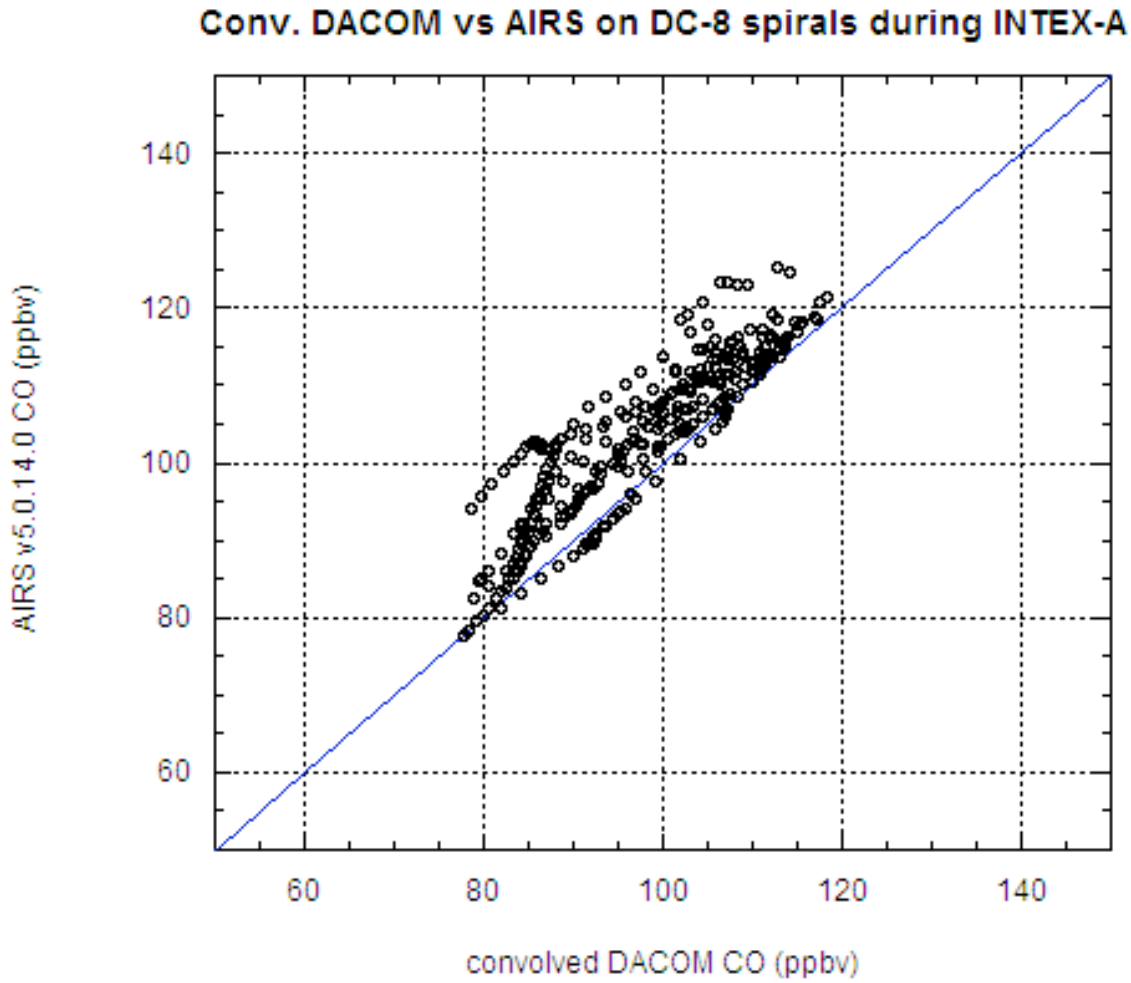




AIRS Science Team Meeting

4/16/08

INTEX-A: AIRS vs. DC-8 in situ



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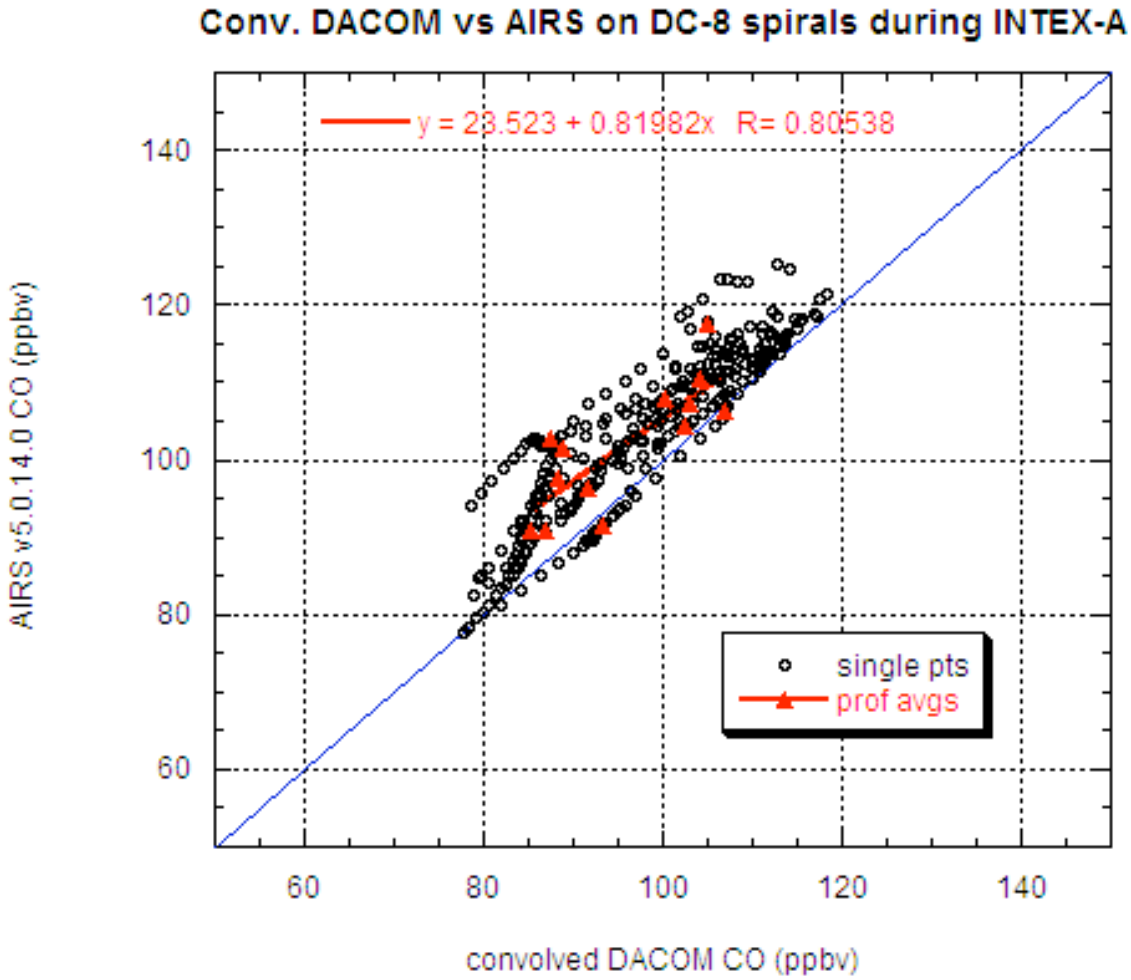

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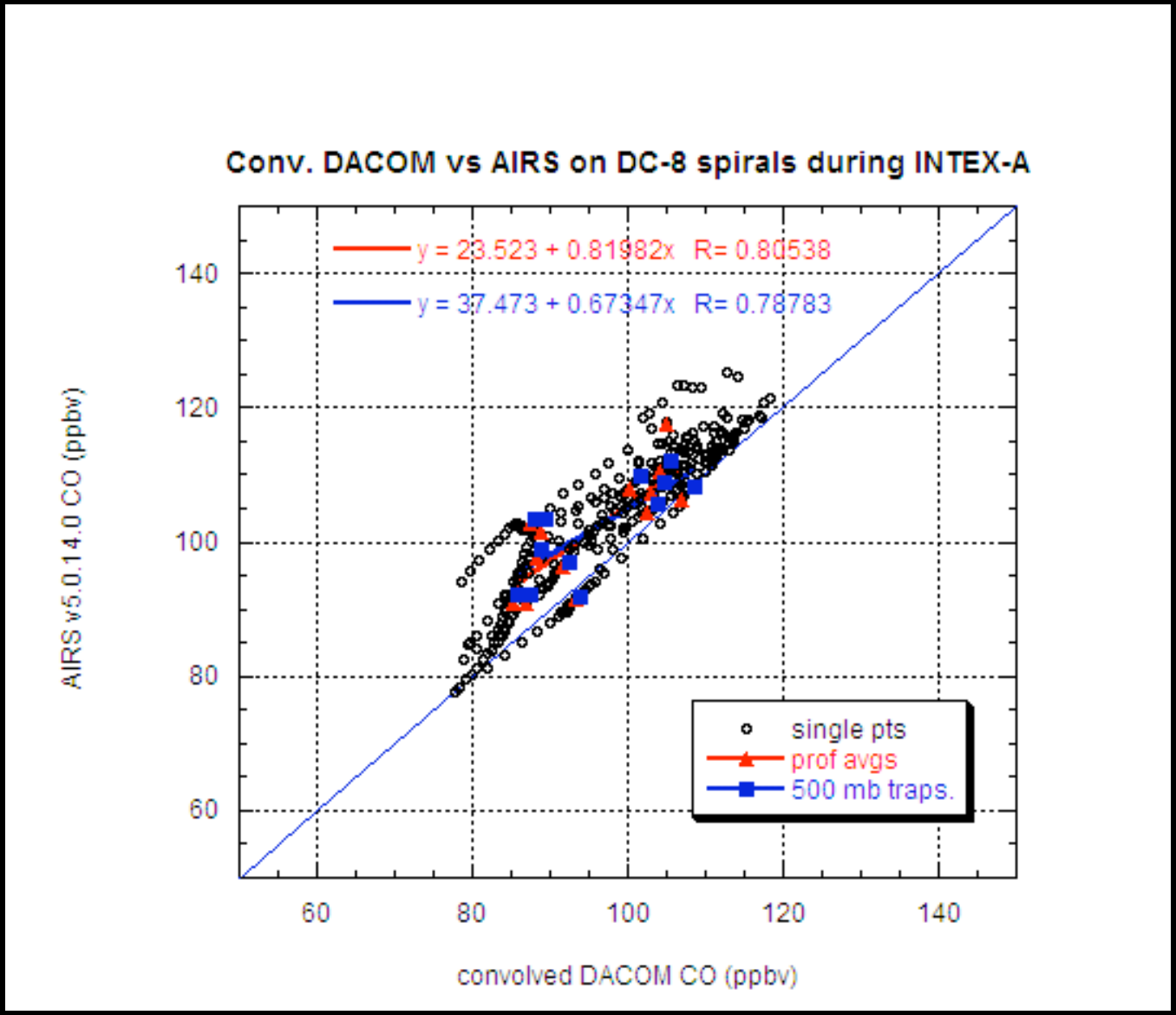

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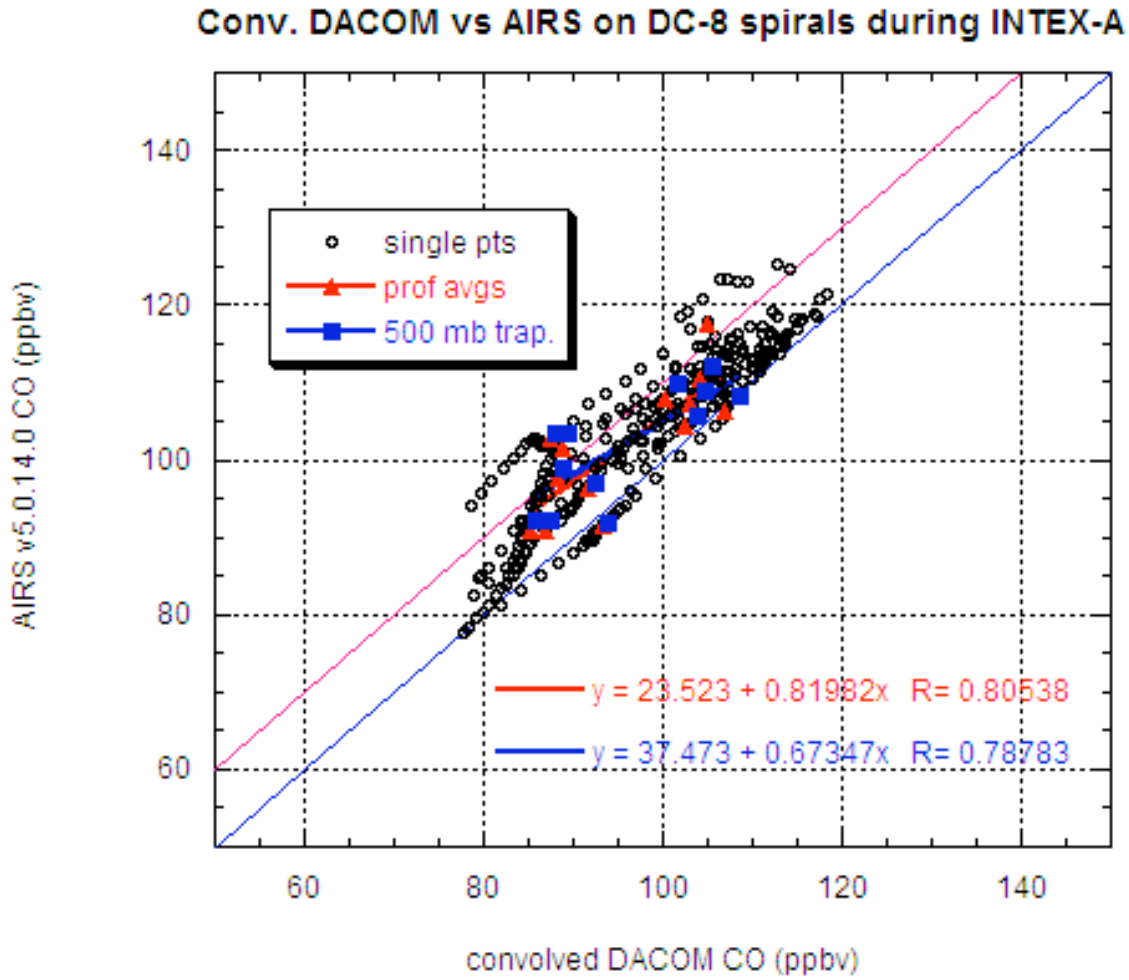

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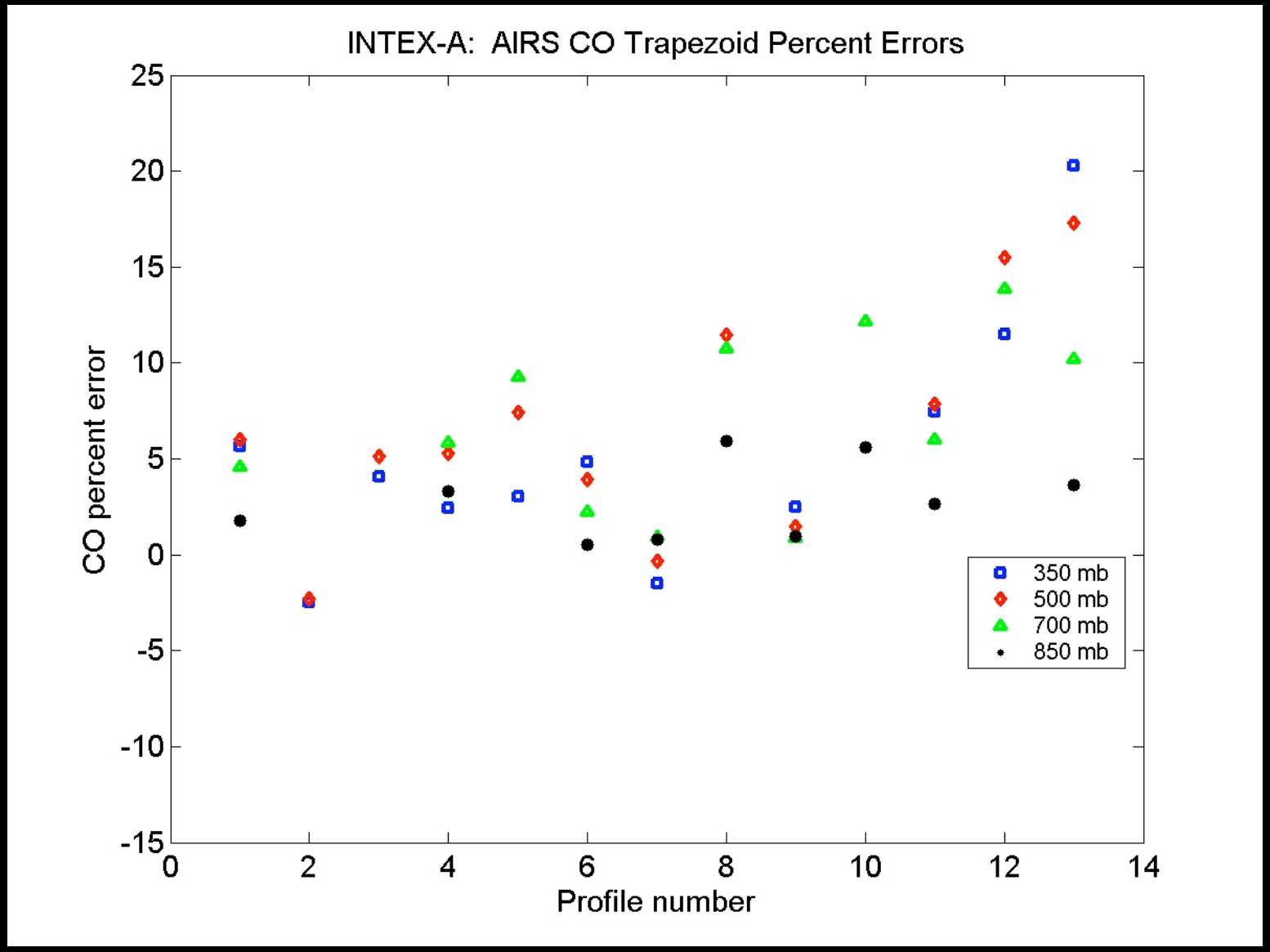

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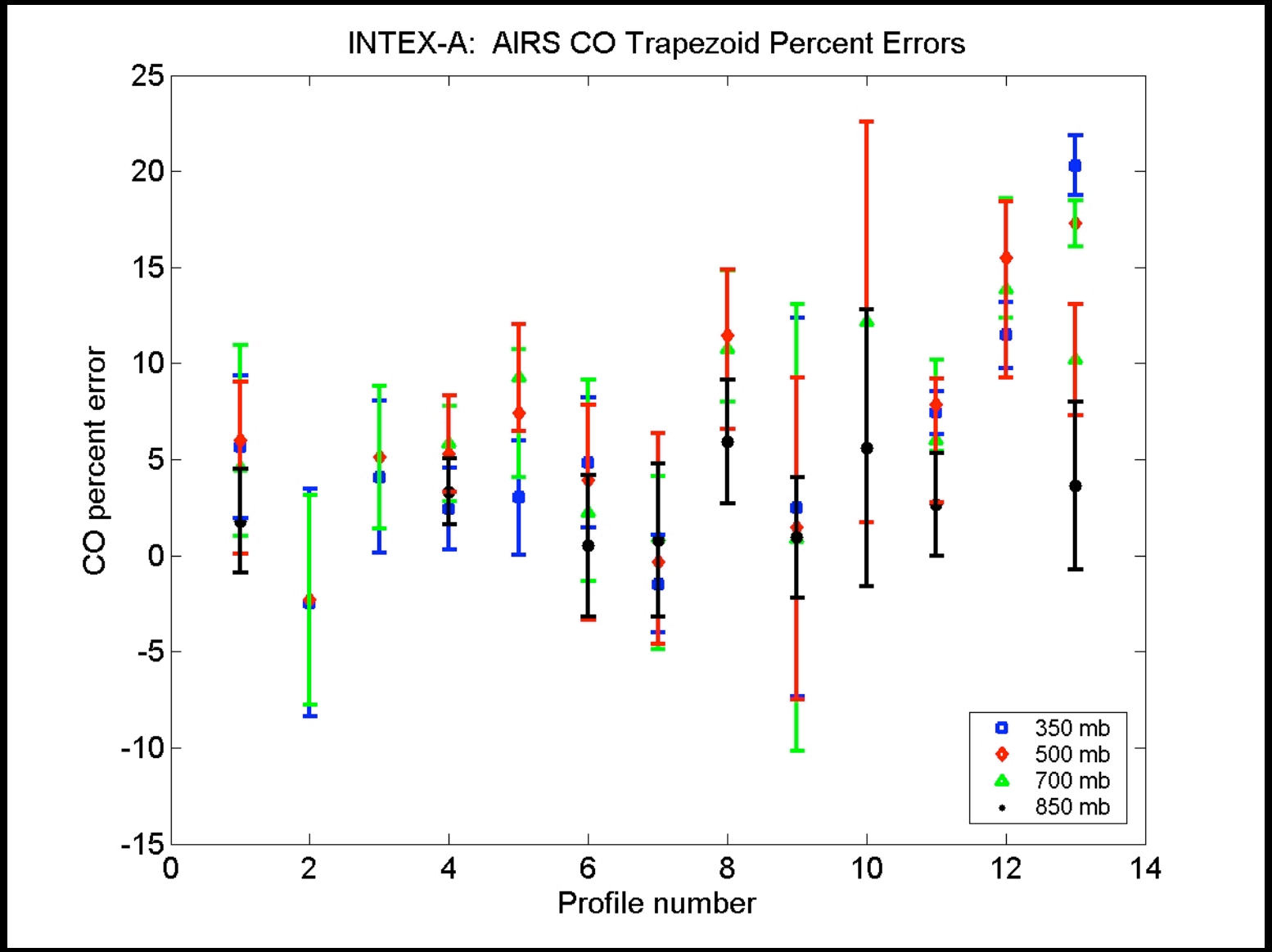

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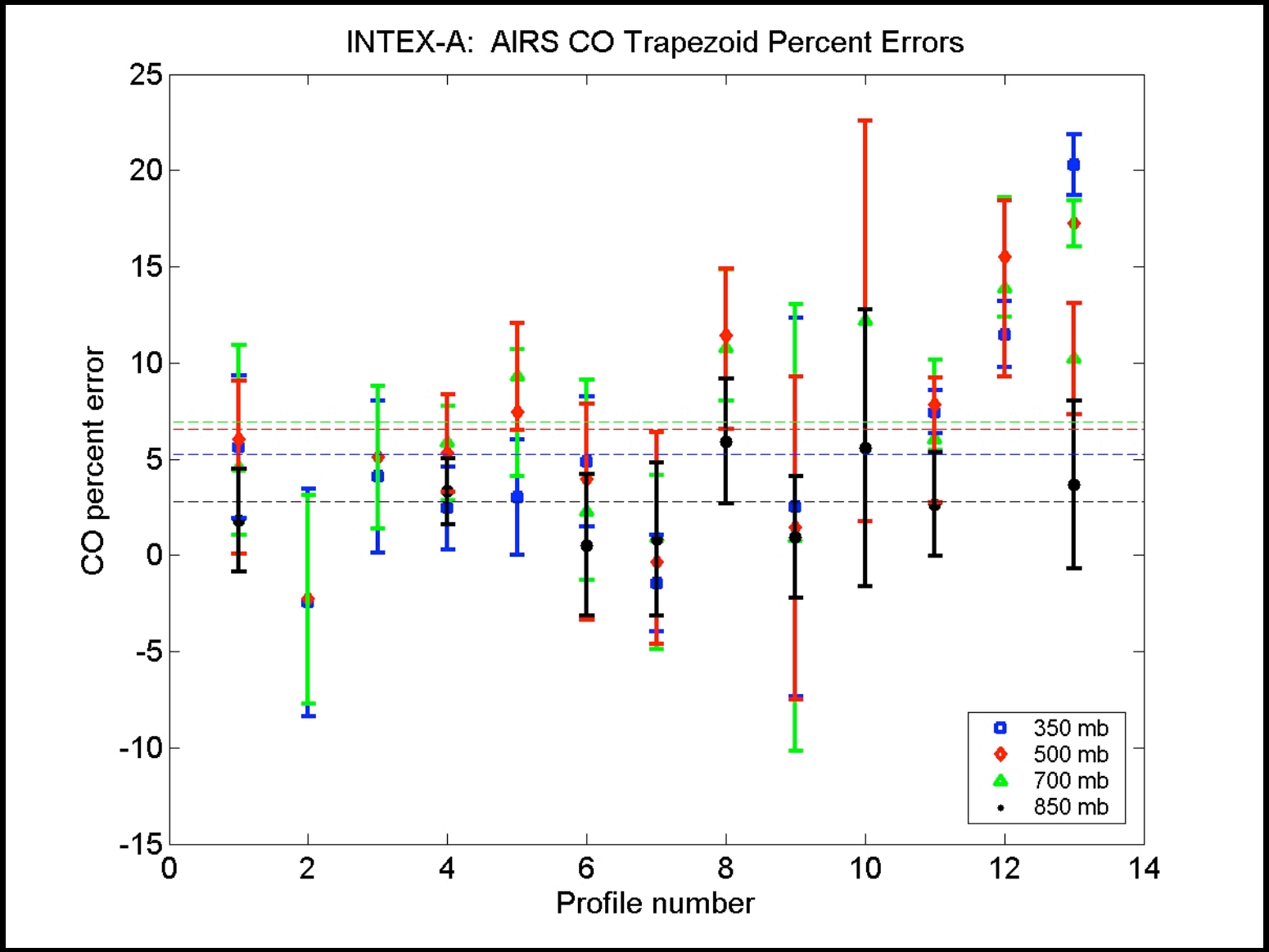

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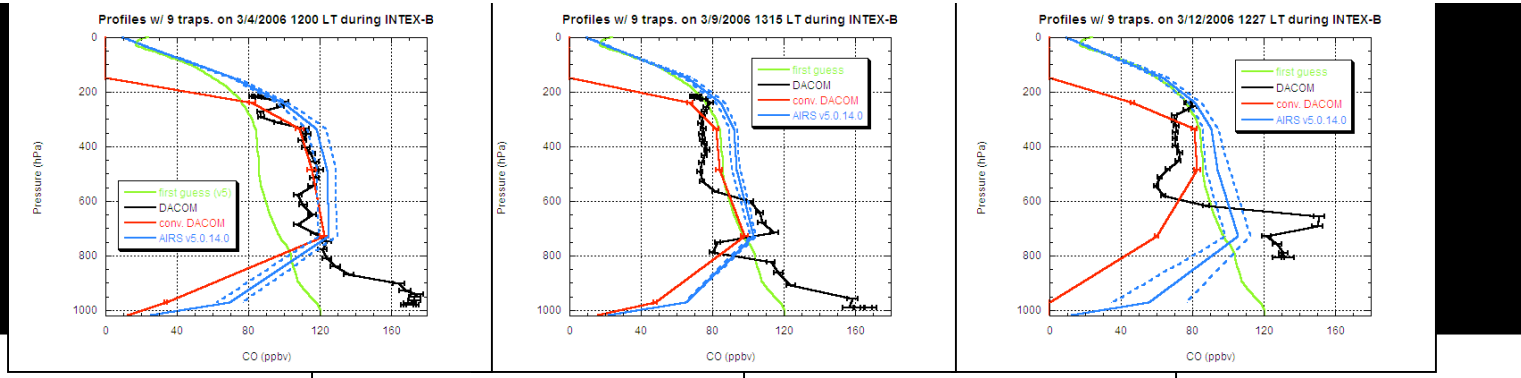
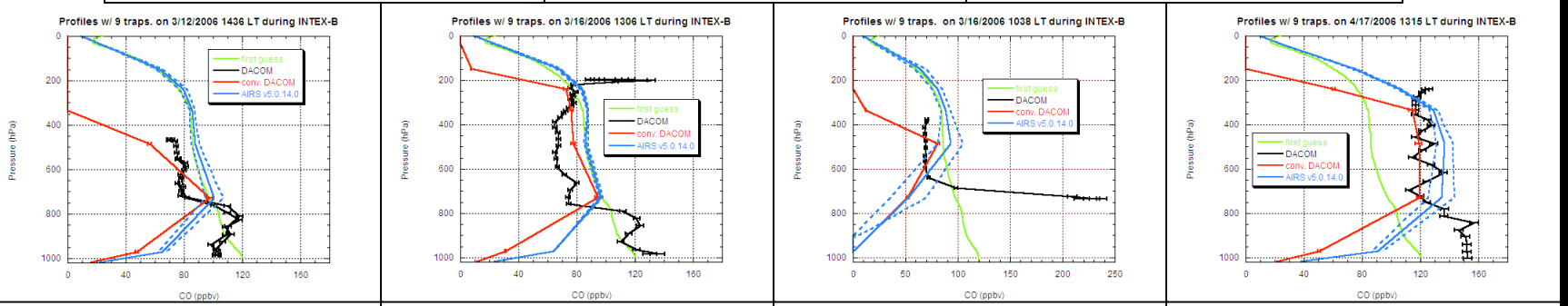
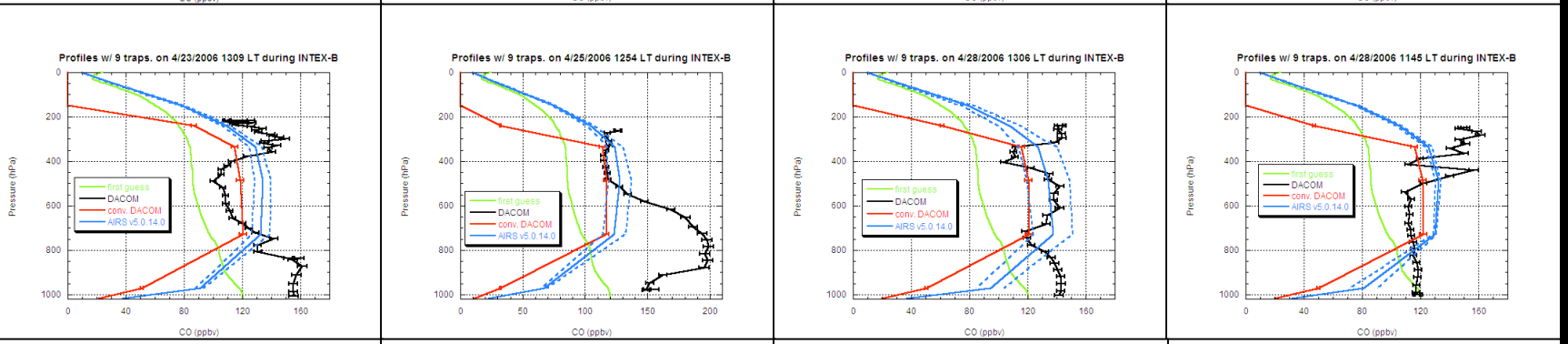
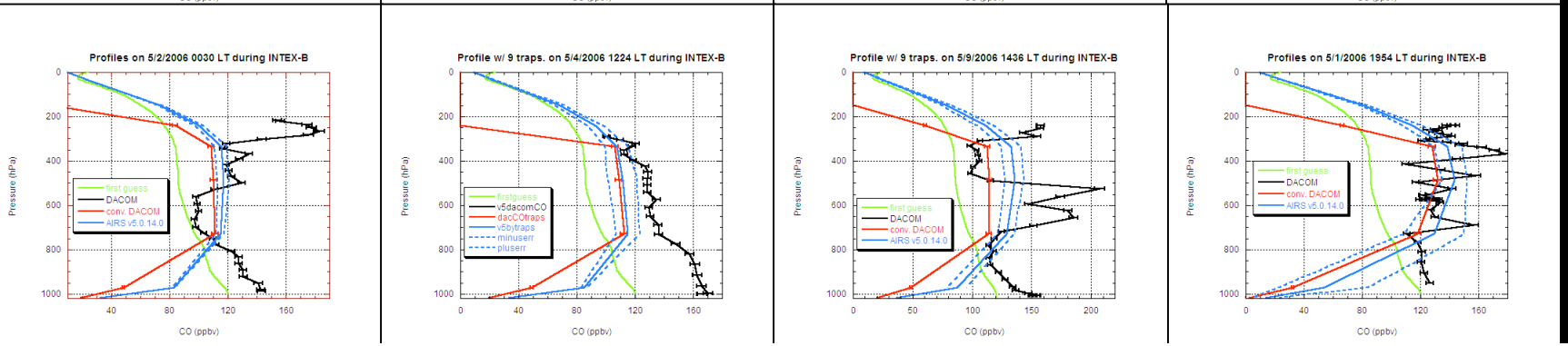
MILAGRO/INTEX-B

- Intercontinental transport of Asian pollution to the US and Mexico City pollution transport to US
  - NASA DC-8: Gulf of Mexico and cent. Pacific
  - March-May 2006
- NASA DC-8 and NSF C-130
- 18 DC-8 spiral validation profiles for AIRS and Aura
  - 15 DC-8 profiles good for AIRS CO validation
- AIRS 500 mb CO: 10% high bias ± 4%

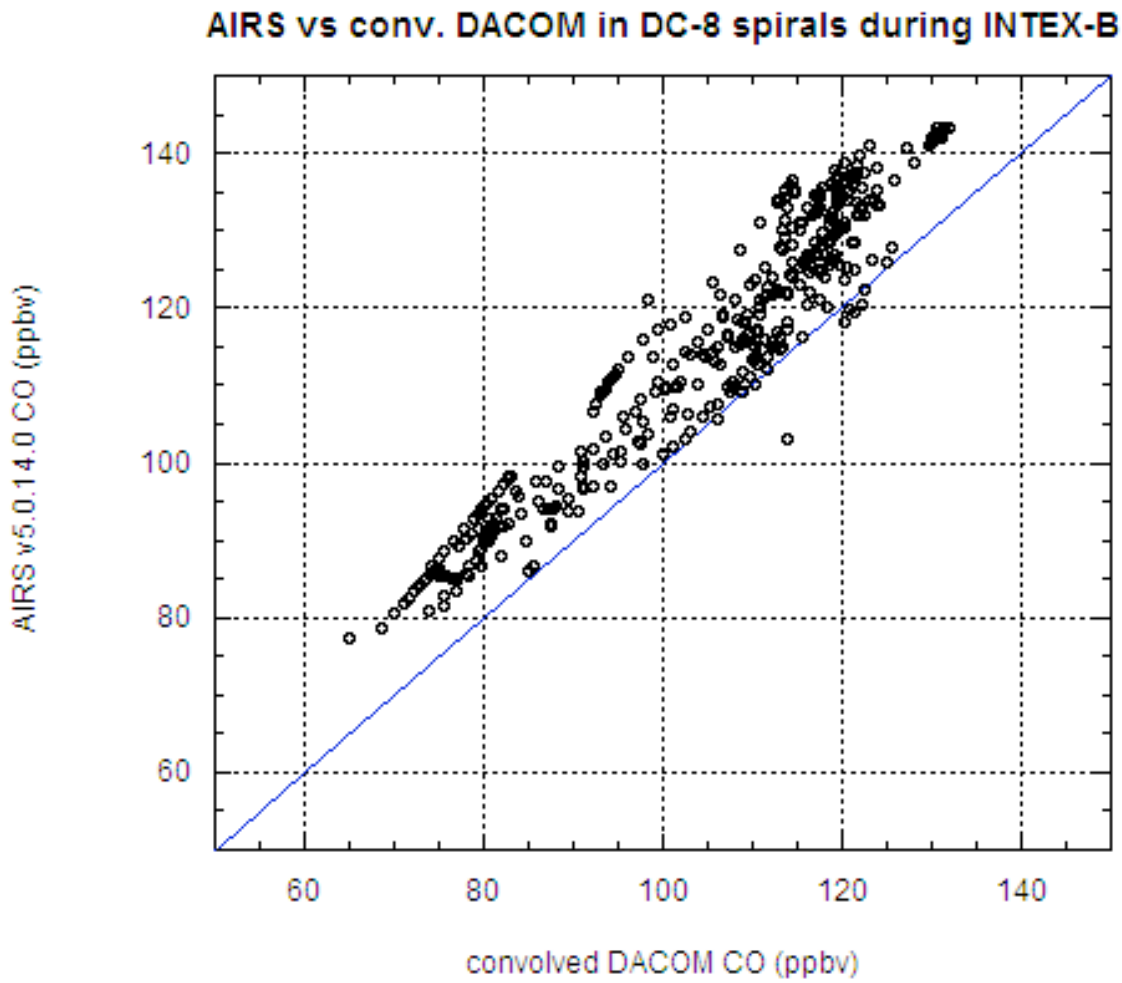

Profiles w/ 9 traps. on 3/4/2006 1200 LT during INTEX-B
Profiles w/ 9 traps. on 3/9/2006 1315 LT during INTEX-B
Profiles w/ 9 traps. on 3/12/2006 1227 LT during INTEX-B
Pressure (hPa)
CO (ppbv)
first guess (v5)
first guess
DACOM
conv. DACOM
AIRS v5.0.14.0


Profiles w/ 9 traps. on 3/12/2006 1436 LT during INTEX-B
Profiles w/ 9 traps. on 3/16/2006 1306 LT during INTEX-B
Profiles w/ 9 traps. on 3/16/2006 1038 LT during INTEX-B
Profiles w/ 9 traps. on 4/17/2006 1315 LT during INTEX-B
Pressure (hPa)
CO (ppbv)
first guess
DACOM
conv. DACOM
AIRS v5.0.14.0


Profiles w/ 9 traps. on 4/23/2006 1309 LT during INTEX-B
Profiles w/ 9 traps. on 4/25/2006 1254 LT during INTEX-B
Profiles w/ 9 traps. on 4/28/2006 1306 LT during INTEX-B
Profiles w/ 9 traps. on 4/28/2006 1145 LT during INTEX-B
Pressure (hPa)
CO (ppbv)
first guess
DACOM
conv. DACOM
AIRS v5.0.14.0


Profiles on 5/2/2006 0030 LT during INTEX-B
Profile w/ 9 traps. on 5/4/2006 1224 LT during INTEX-B
Profile w/ 9 traps. on 5/9/2006 1436 LT during INTEX-B
Profiles on 5/1/2006 1954 LT during INTEX-B
Pressure (hPa)
CO (ppbv)
first guess
DACOM
conv. DACOM
AIRS v5.0.14.0
v5dacomCO
dacOtraps
v5bytraps
minuserr
pluserr

INTEX-B: AIRS vs. DC-8 in situ



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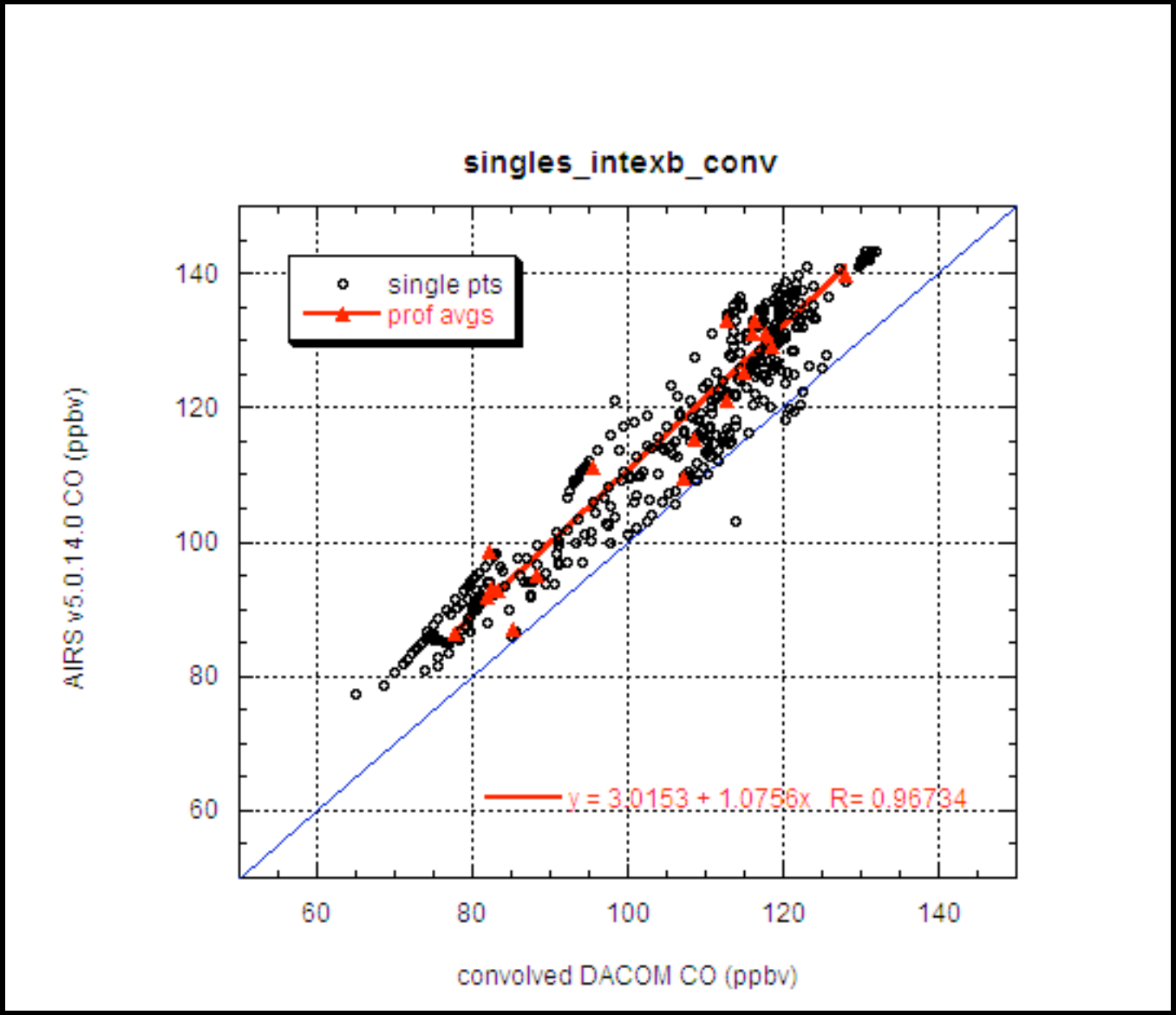
INTEX-B: AIRS vs. DC-8 in situ



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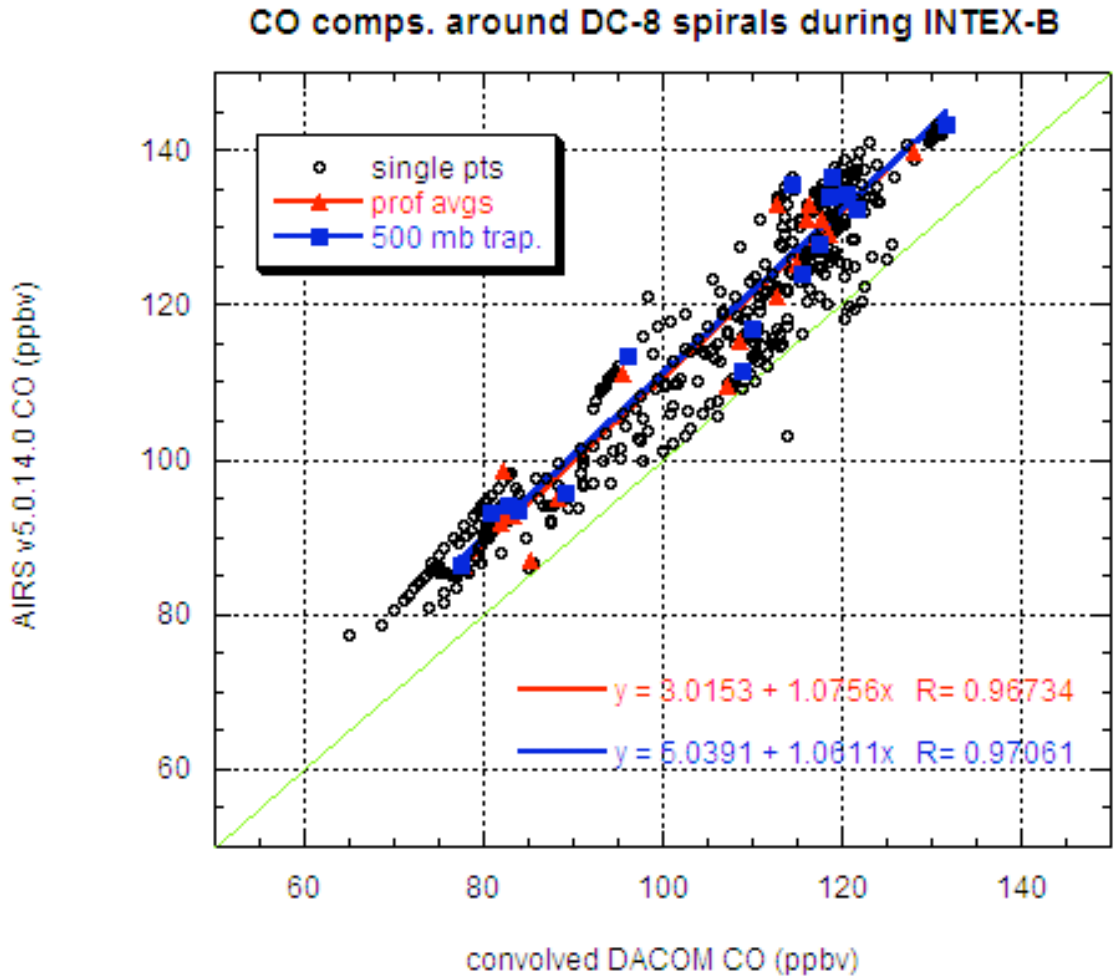
INTEX-B: AIRS vs. DC-8 in situ



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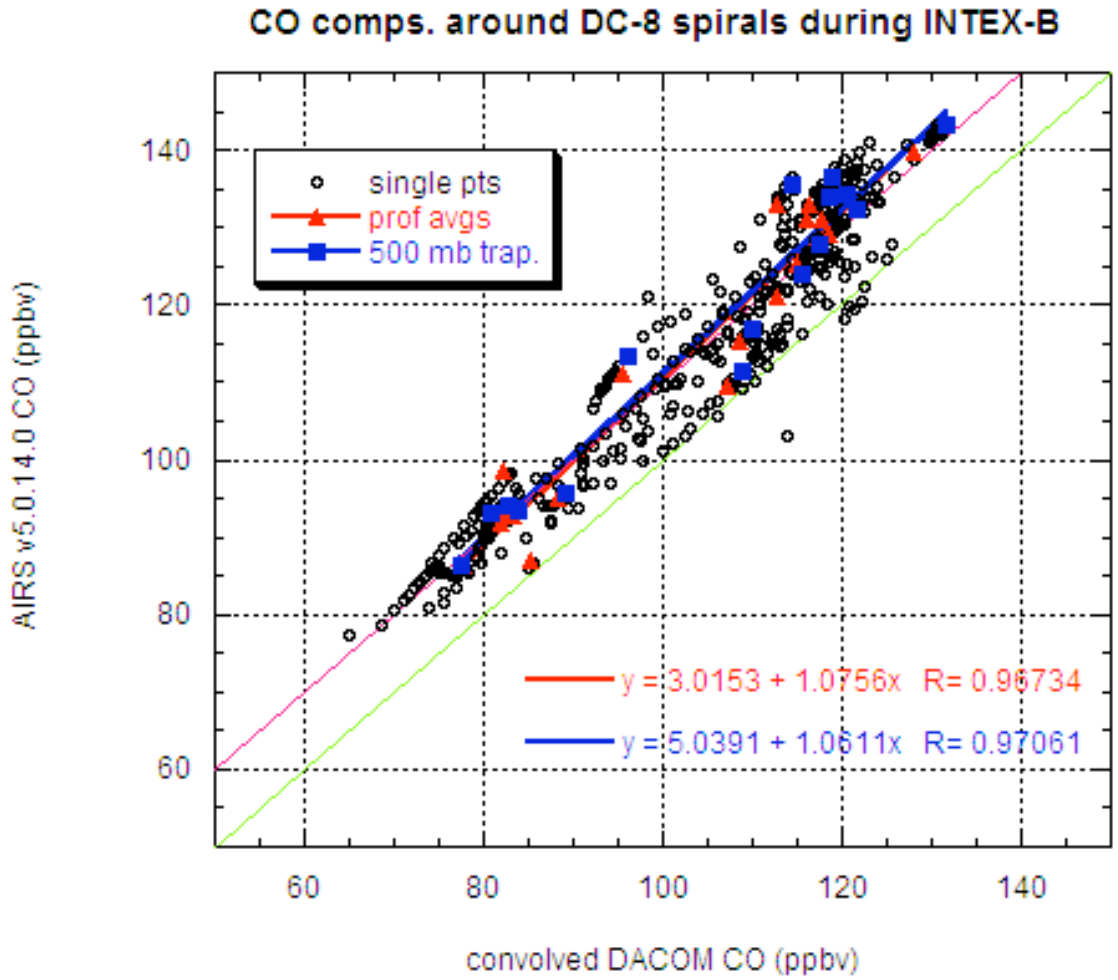
INTEX-B: AIRS vs. DC-8 in situ



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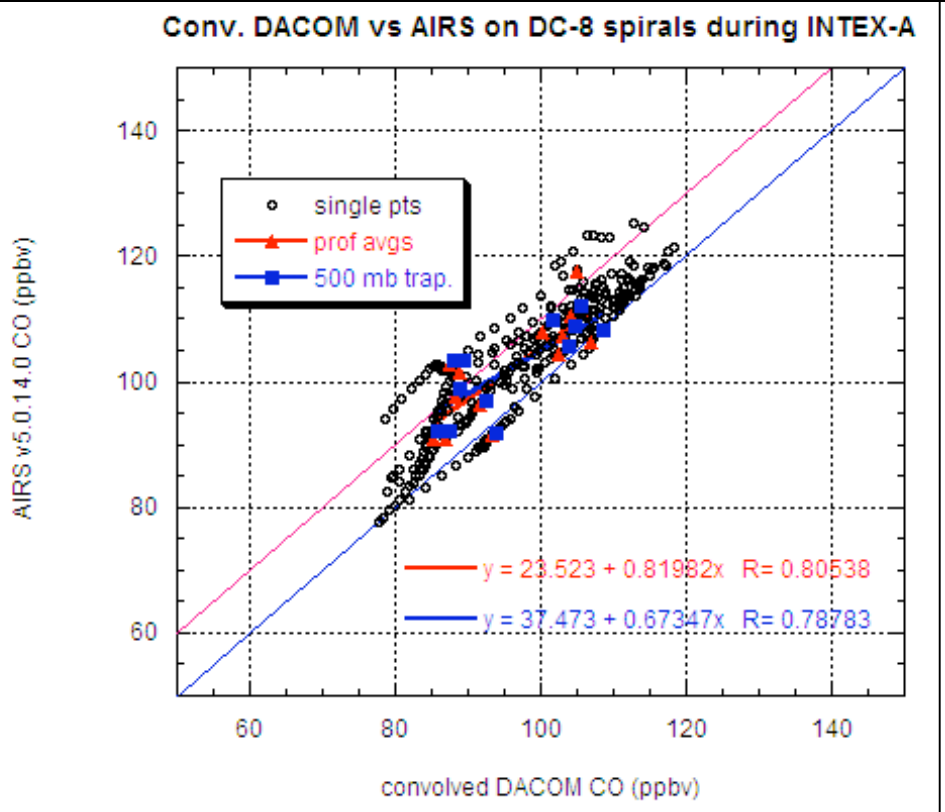

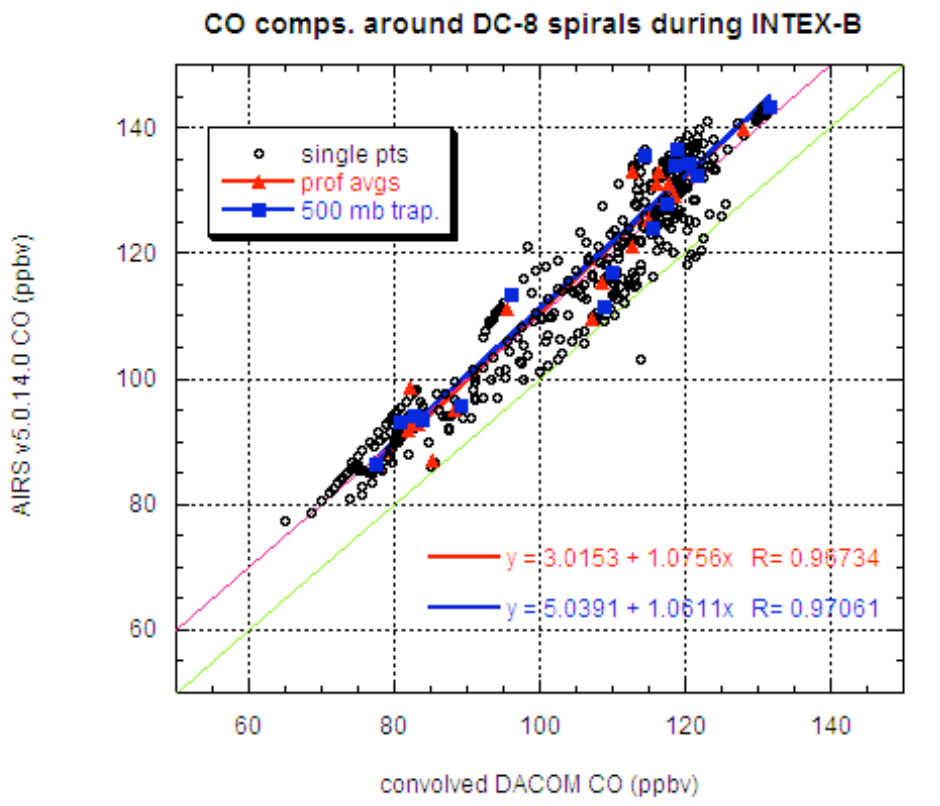

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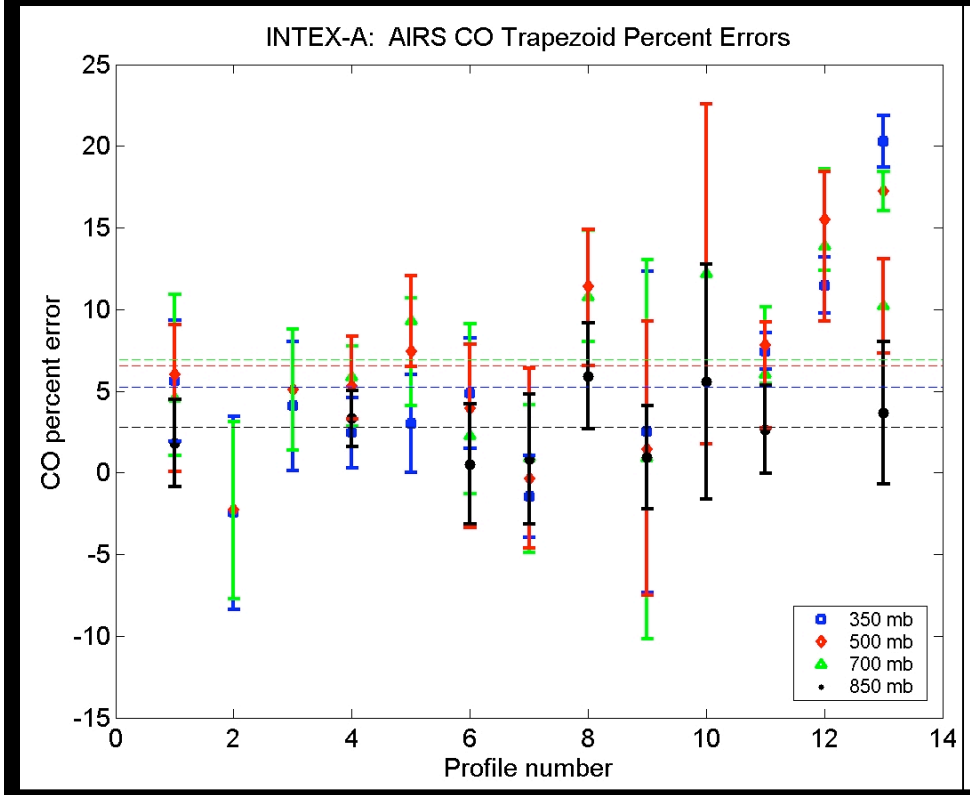

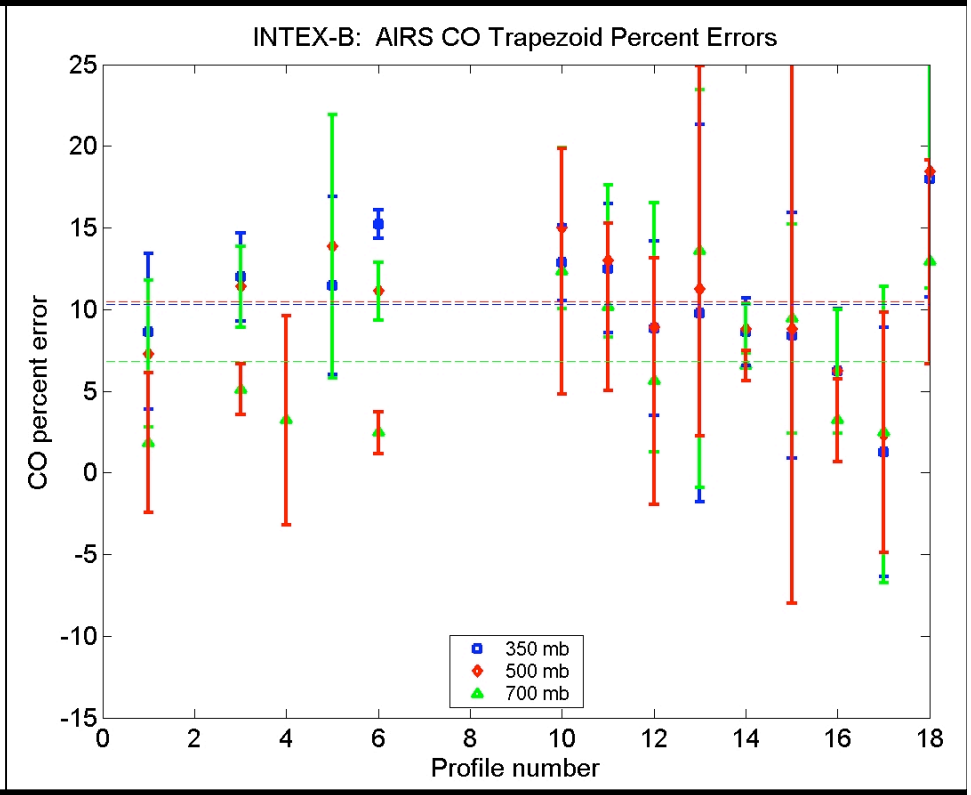

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INTEX A and B Results

trapezoid pressure	# profiles A/B	mean % error A/B	std A/B
350 mb	11/10	5.3/10.3	4.2/6.3
500 mb	12/10	6.5/10.5	5.9/4.2
700 mb	11/10	7.0/6.9	4.6/4.3
850 mb	11/NA*	2.0/NA*	2.8/NA*

* UMBC processing error for INTEX-B lower trapezoids to be fixed

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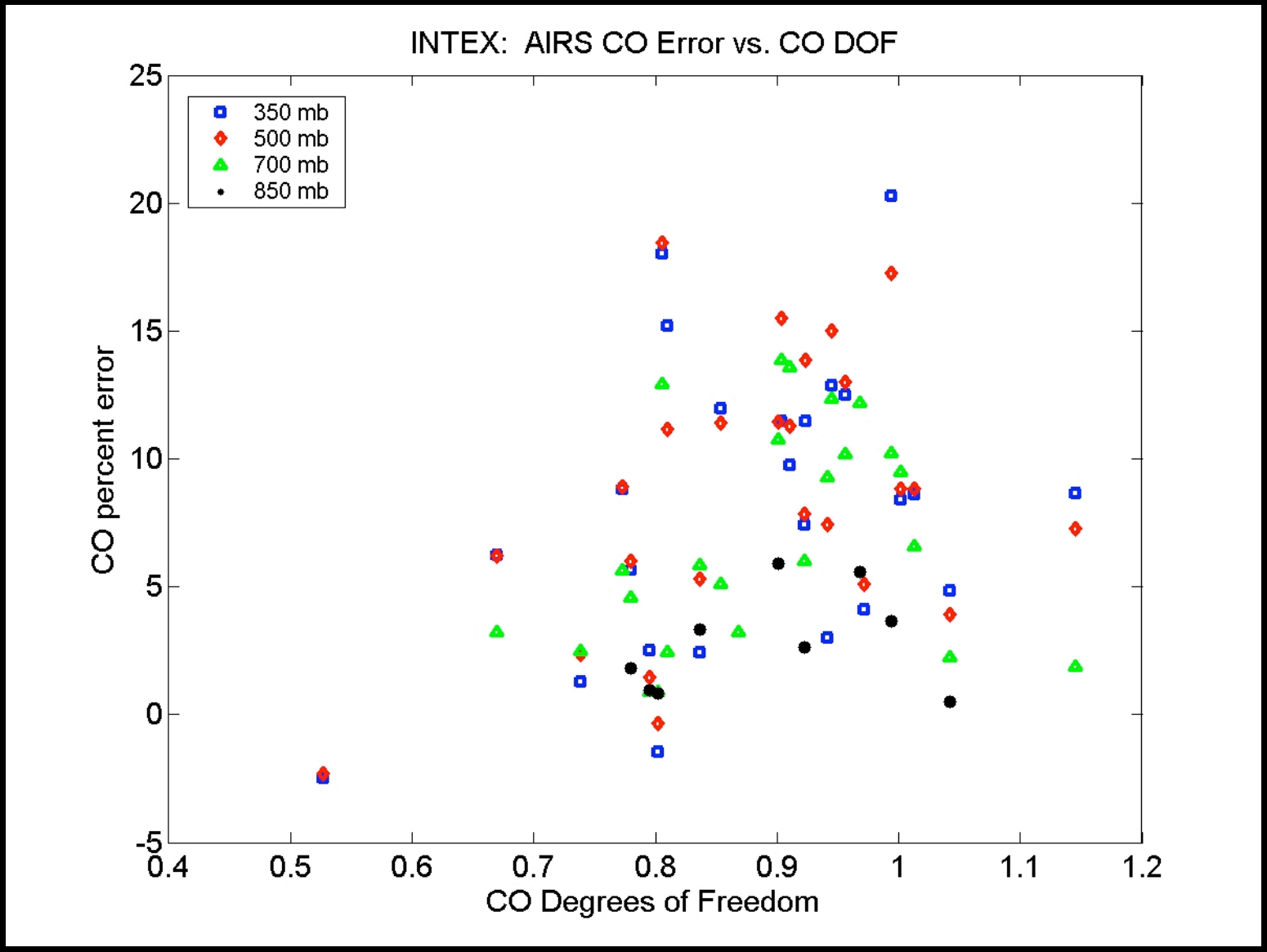

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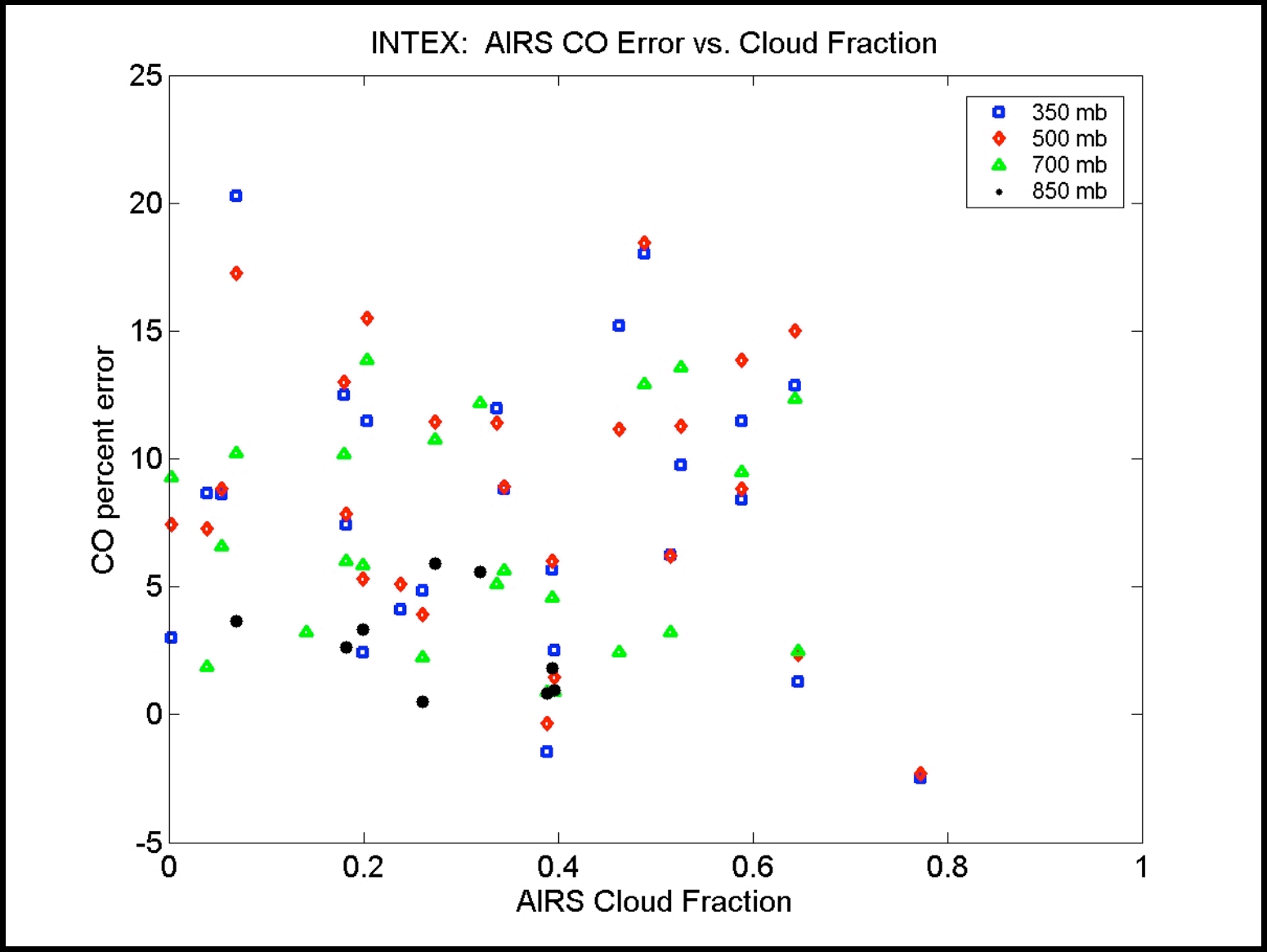
INTEX: AIRS vs. DC-8 in situ



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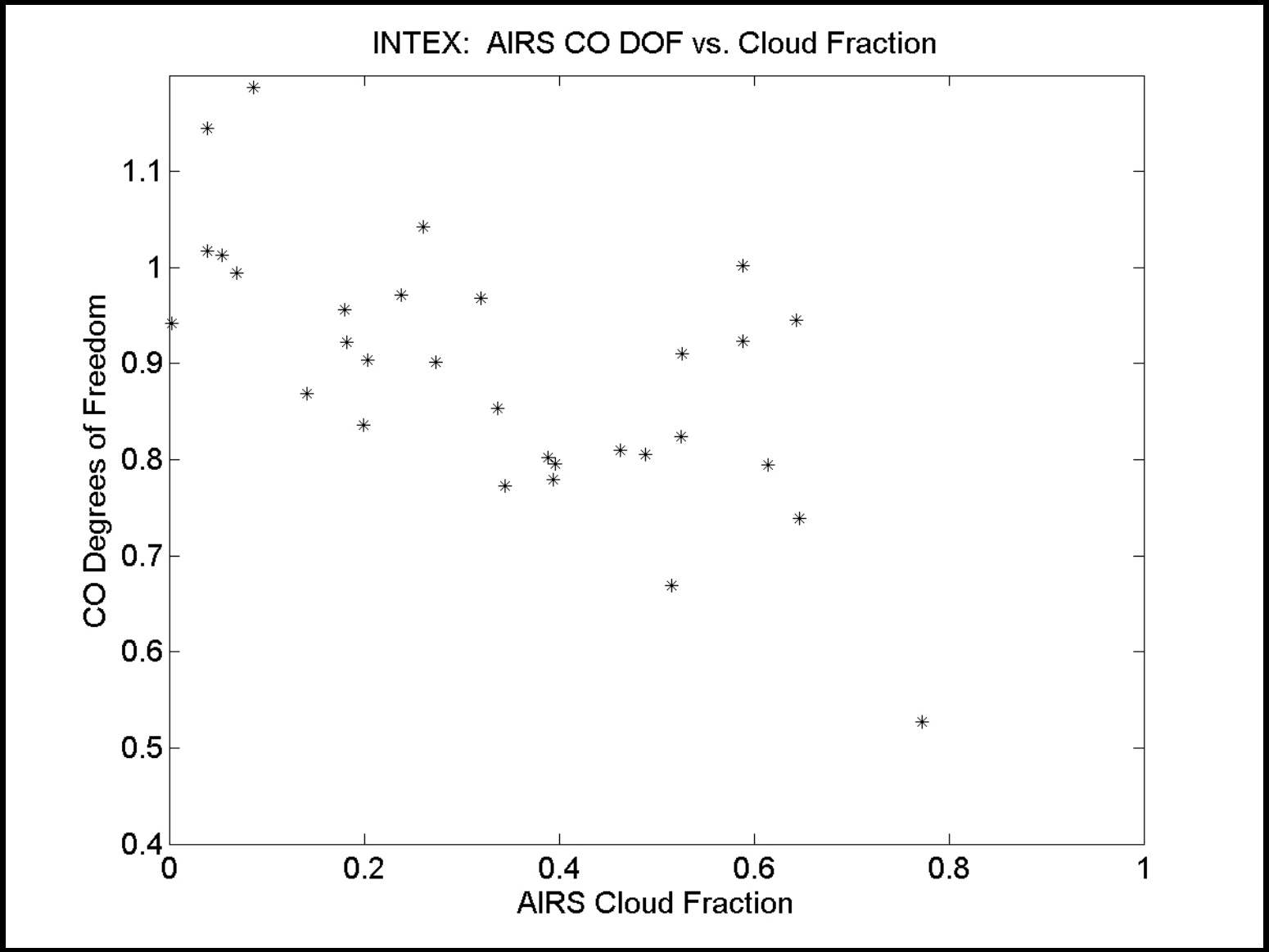
INTEX: AIRS vs. DC-8 in situ



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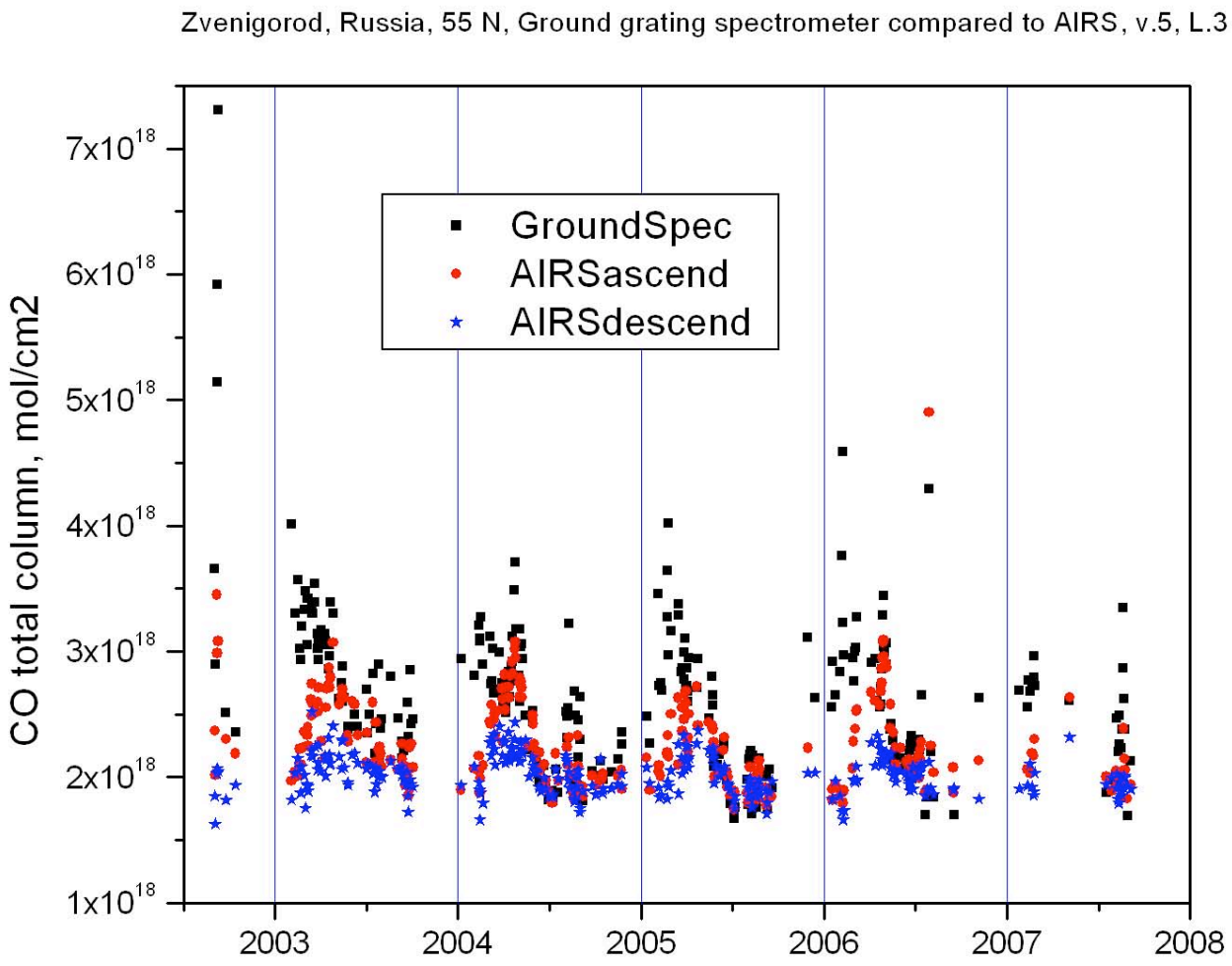
Ground-based total column CO

- Use NDACC (Network for Detection of Atmosphere Composition Change) solar tracking ground stations
- 7 Stations used thus far
  - NH: 5
  - SH: 2
- AIRS total column CO:
  - NH: AIRS 0 to 10% high bias for DOF > 0.8
  - SH: AIRS 10 to 20% high bias for DOF > 0.8
  - Error is a function of CO degrees of freedom

Total Column Comparisons



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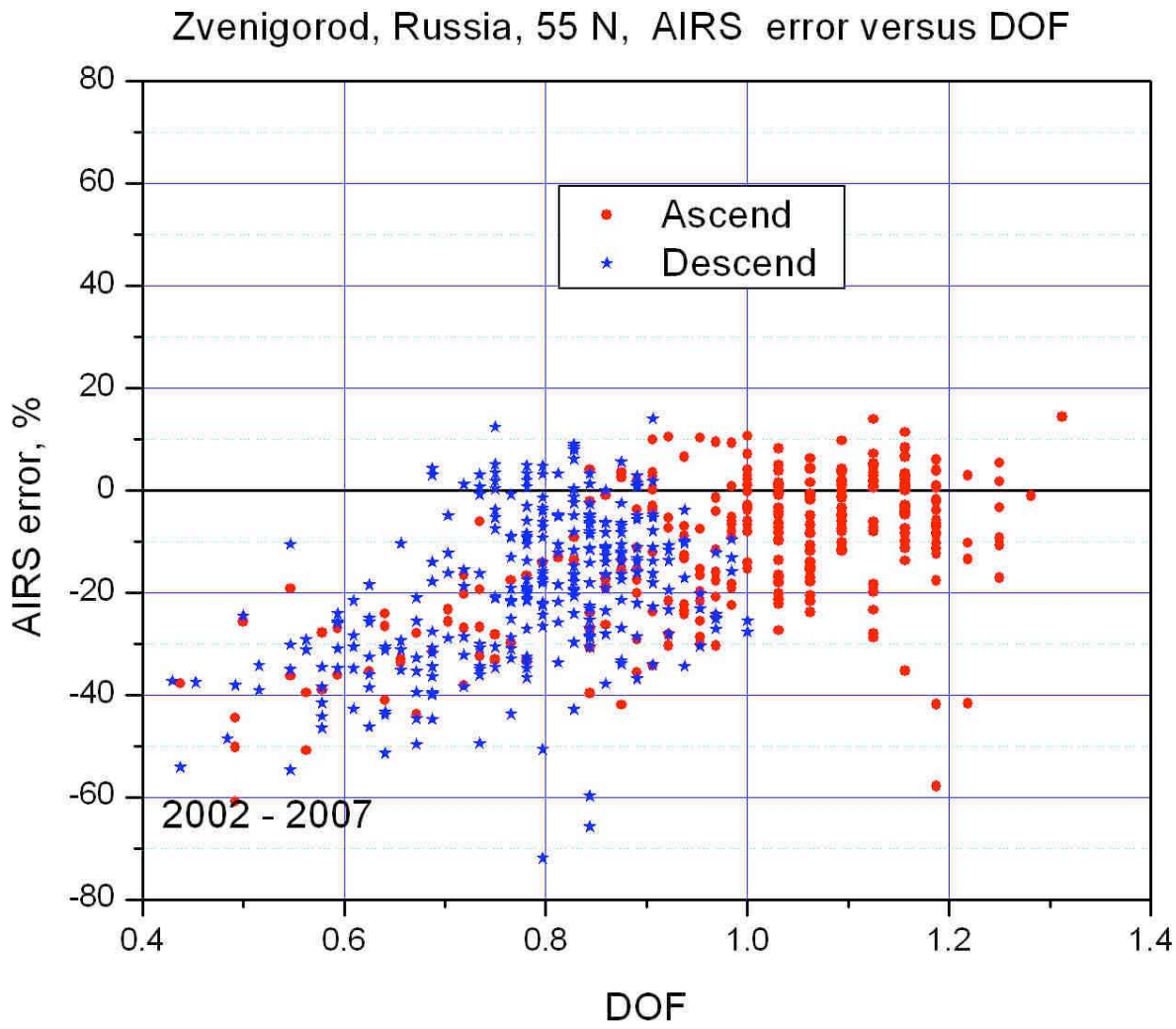
Total Column Comparisons



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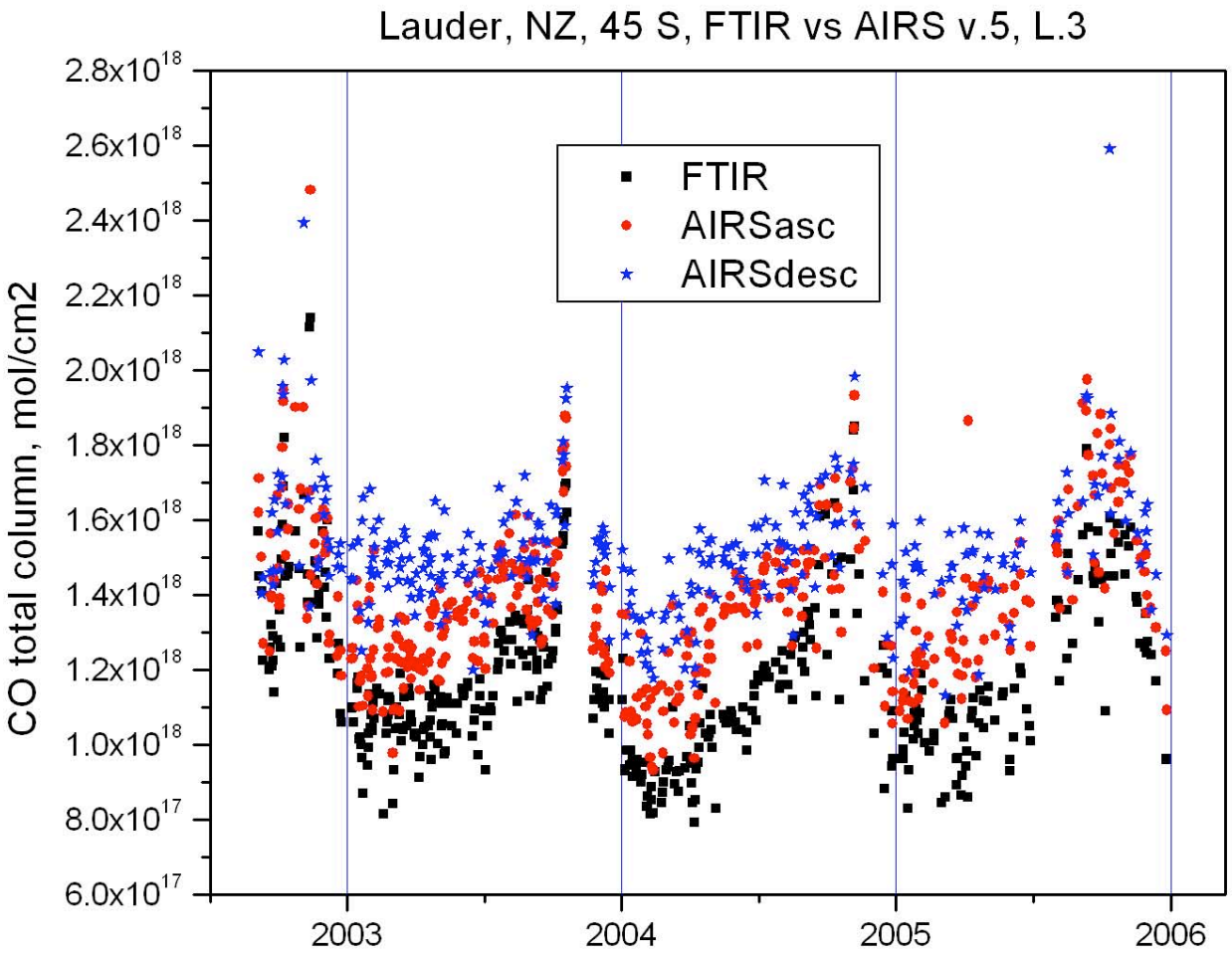

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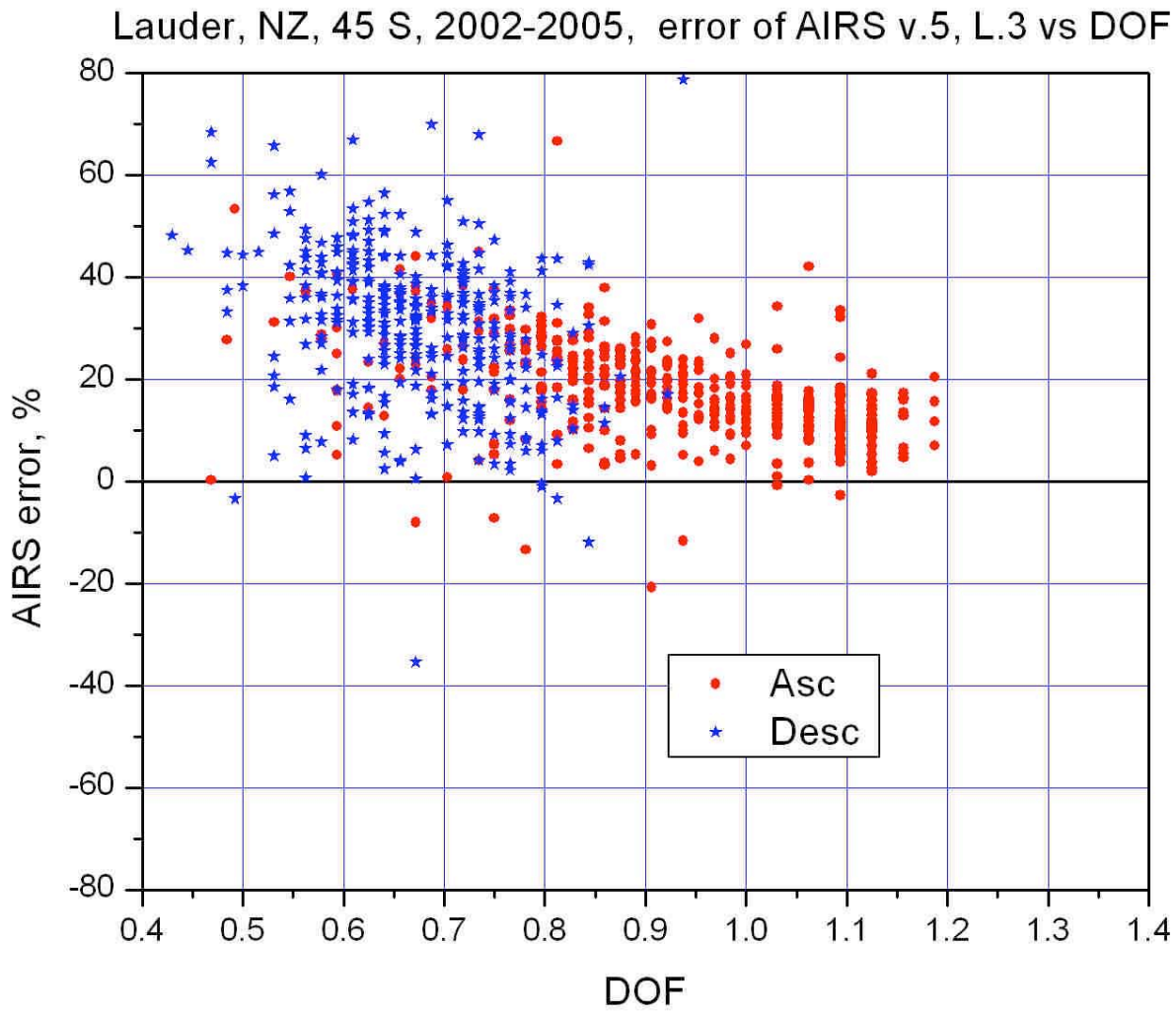
Total Column Comparisons



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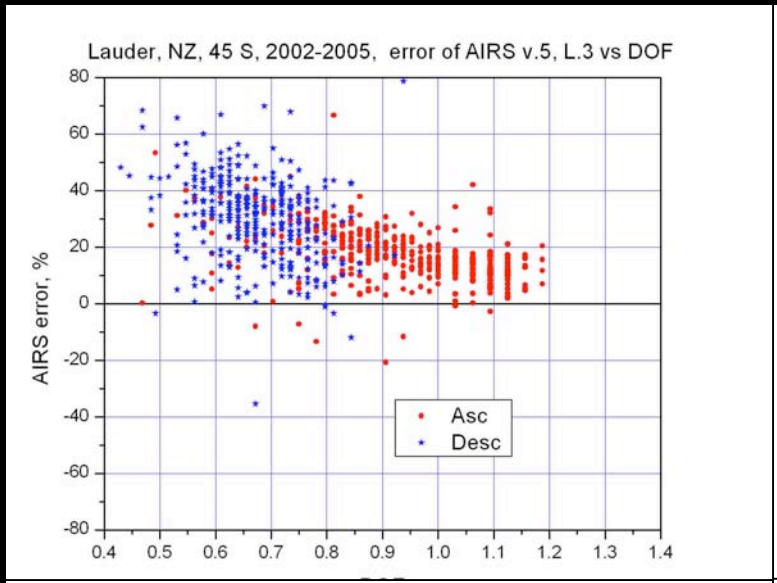
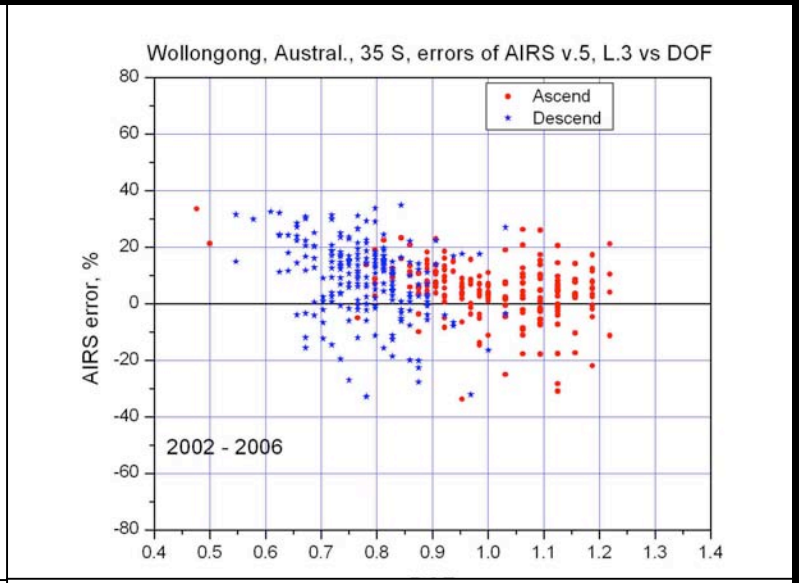
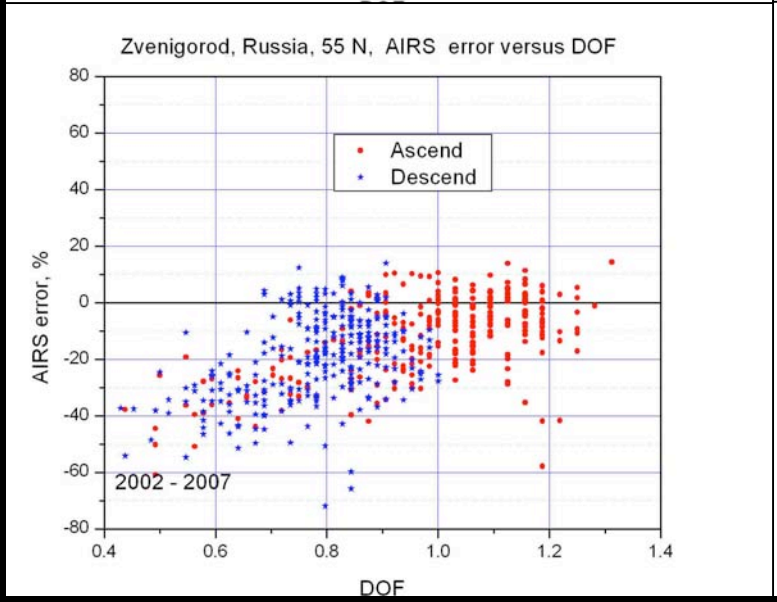
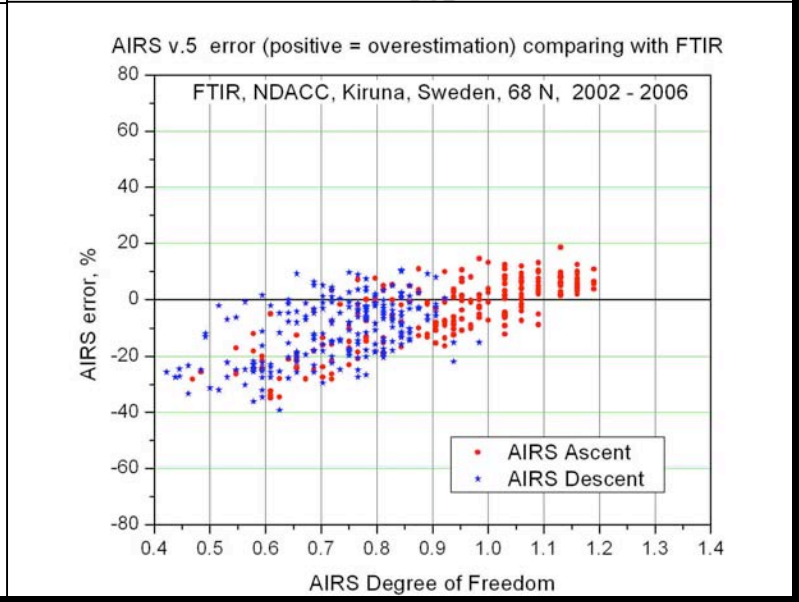
Total Column Comparisons









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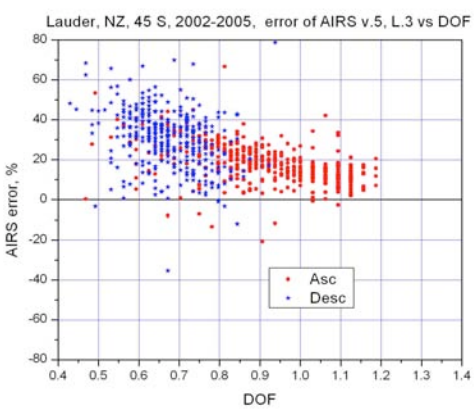

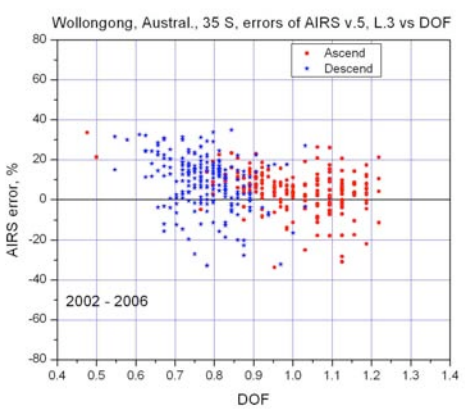

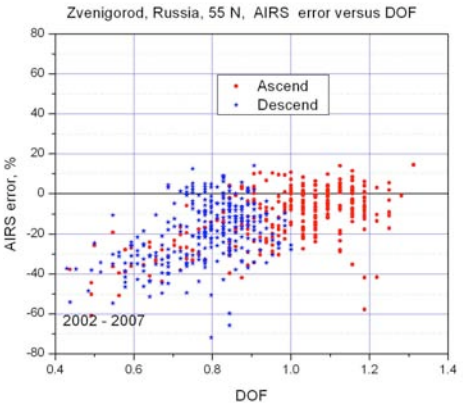

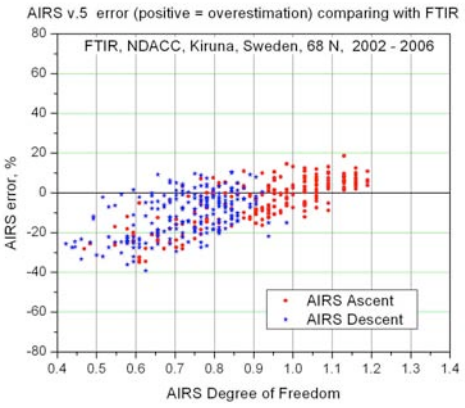

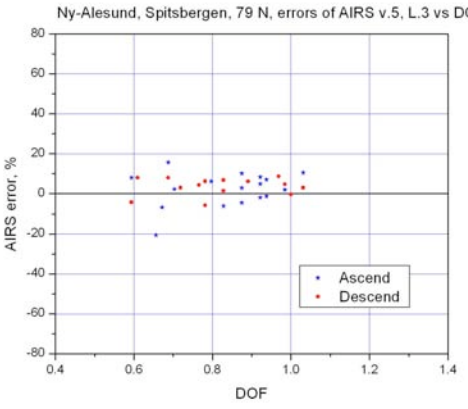

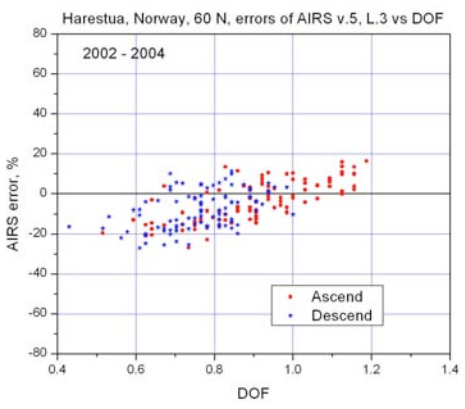

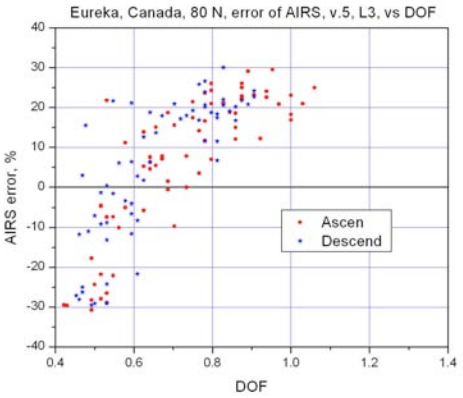

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Surface and PBL CO

- Measurements from Oklahoma SGP site
  - PBL CO retrieved from AERI spectra
    - Separate AERI validation underway
  - Surface in situ CO abundance
- AIRS near surface vs. AERI PBL
  - Now well correlated
  - AIRS dynamic range suppressed
- AIRS near surface vs. surface in situ
  - AIRS 30% low bias and large σ

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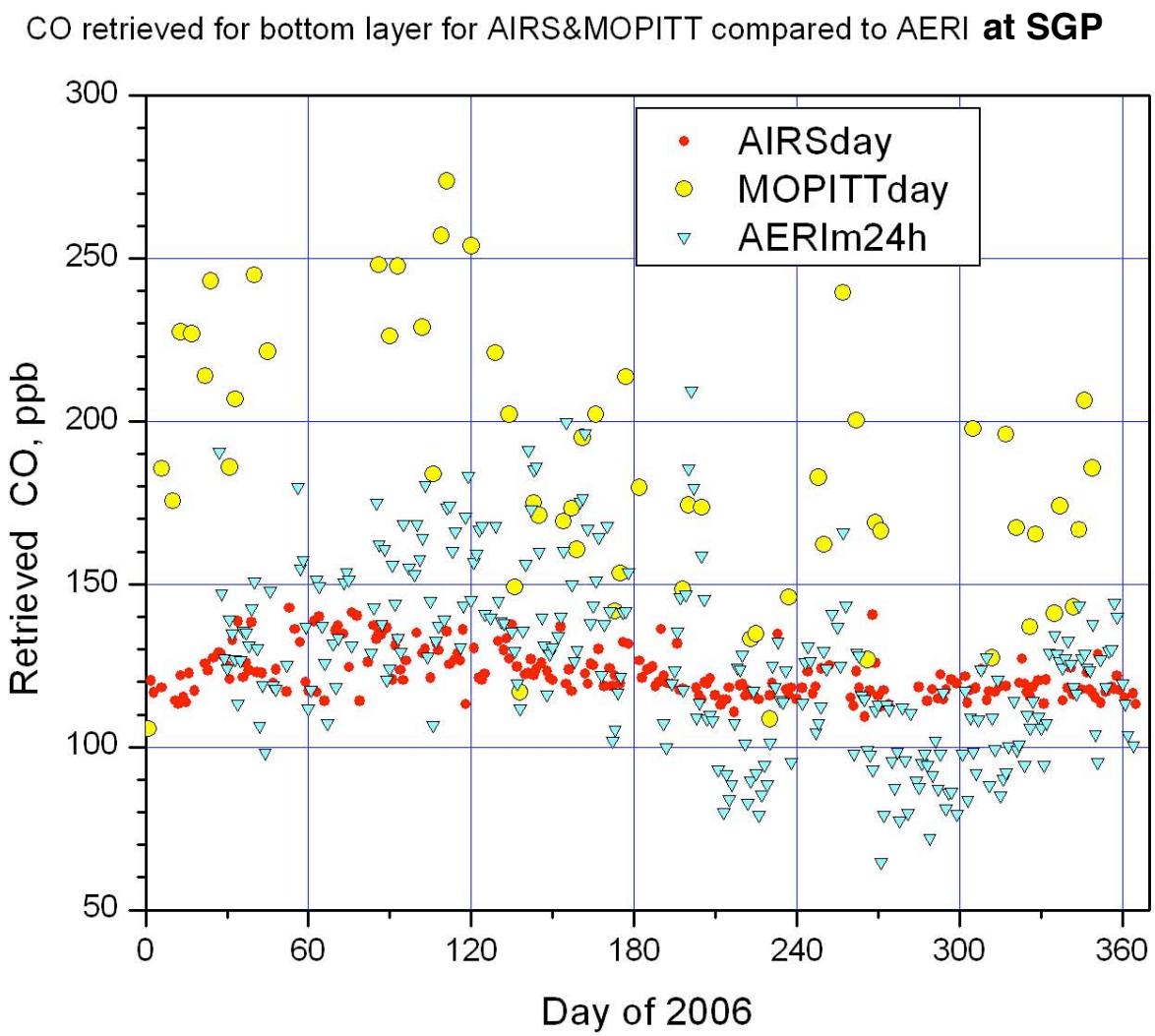
PBL and Surface Comparisons



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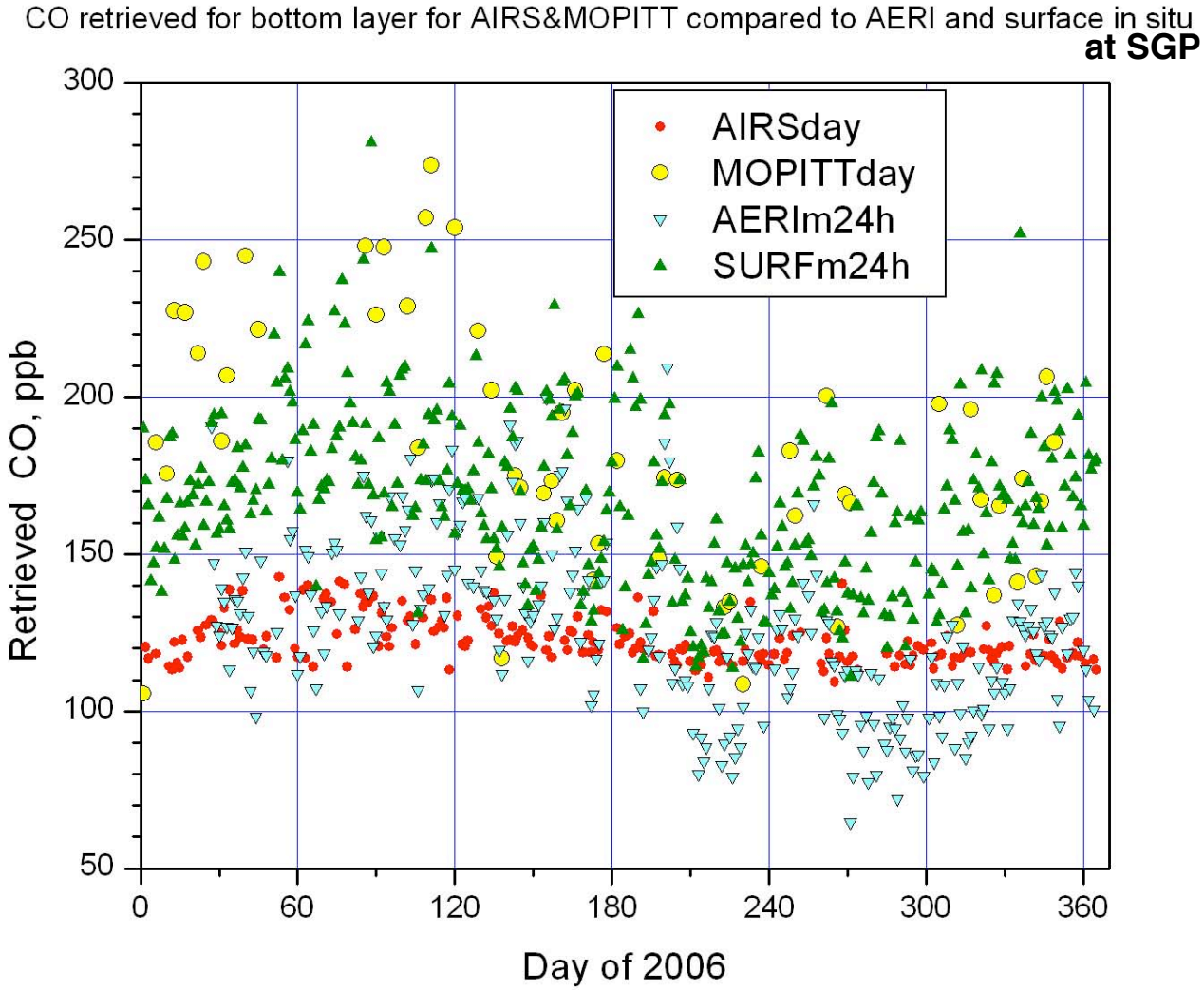
PBL and Surface Comparisons



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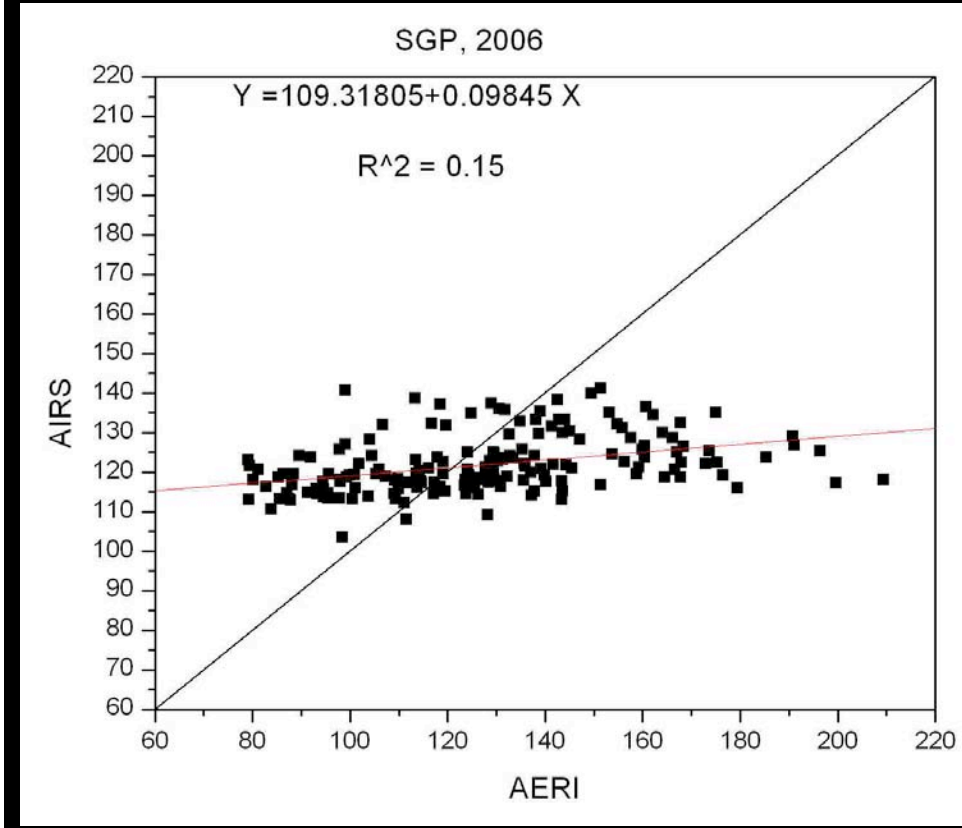
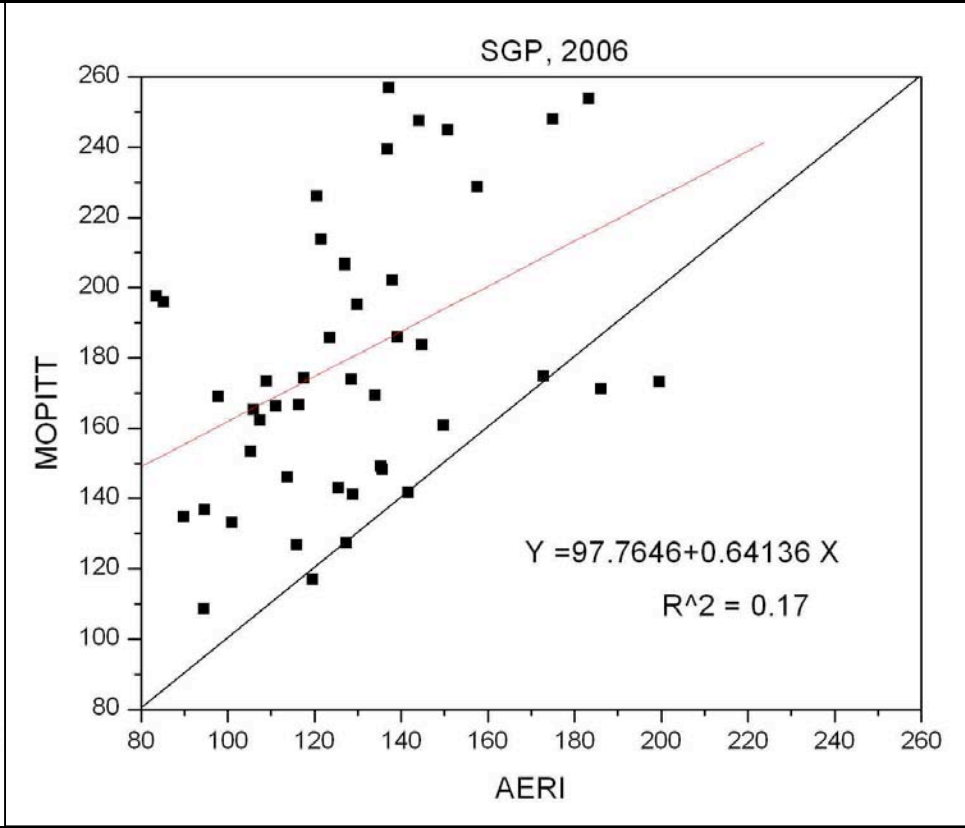
PBL and Surface Comparisons





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SUMMARY

- AIRS 500 mb vs. DC-8 in situ
  - INTEX-A: AIRS 5% high bias ± 5% σ
  - INTEX-B: AIRS 10% high bias ± 5% σ
- AIRS total column vs. ground-based FTIR
  - NH: AIRS 0 to 10% high bias for DOF > 0.8
  - SH: AIRS 10 to 20% high bias for DOF > 0.8
- AIRS near surface vs. AERI PBL
  - AIRS bias near 0% but large σ
- AIRS near surface vs. surface in situ
  - AIRS 30% low bias and large σ

NEXT STEPS

- Compare to all INTEX profiles
  - Not just validation spirals of DC-8 (100 more)
  - All aircraft (100+ more)
- Expand to other research aircraft and MOZAIC profiles (thousands more)
- Expand to all NDACC stations
- Use full AERI timeseries (2002-present)
- Test potential v6 AIRS CO retrieval
  - Why is AIRS 500 mb CO biased 5-10% high?

AIRS CO Science

- Mexico City pollution plume (MILAGRO)
- Transport impacts on Houston pollution from TexAQS2006 (A-Train)
- Interannual variations in CO emissions
  - Boreal forest fires (Siberia, Alaska, Canada)
  - South American fires
  - Indonesian fires (ENSO link)
- Pyrocumulonimbus events (A-Train)
- Carbon cycle and ecosystems
  - Correlations of CO emissions with population density and land-use
  - Assimilation studies of AIRS CO and CO2
- 3-D structure of STE using A-Train CO, O3, H2O

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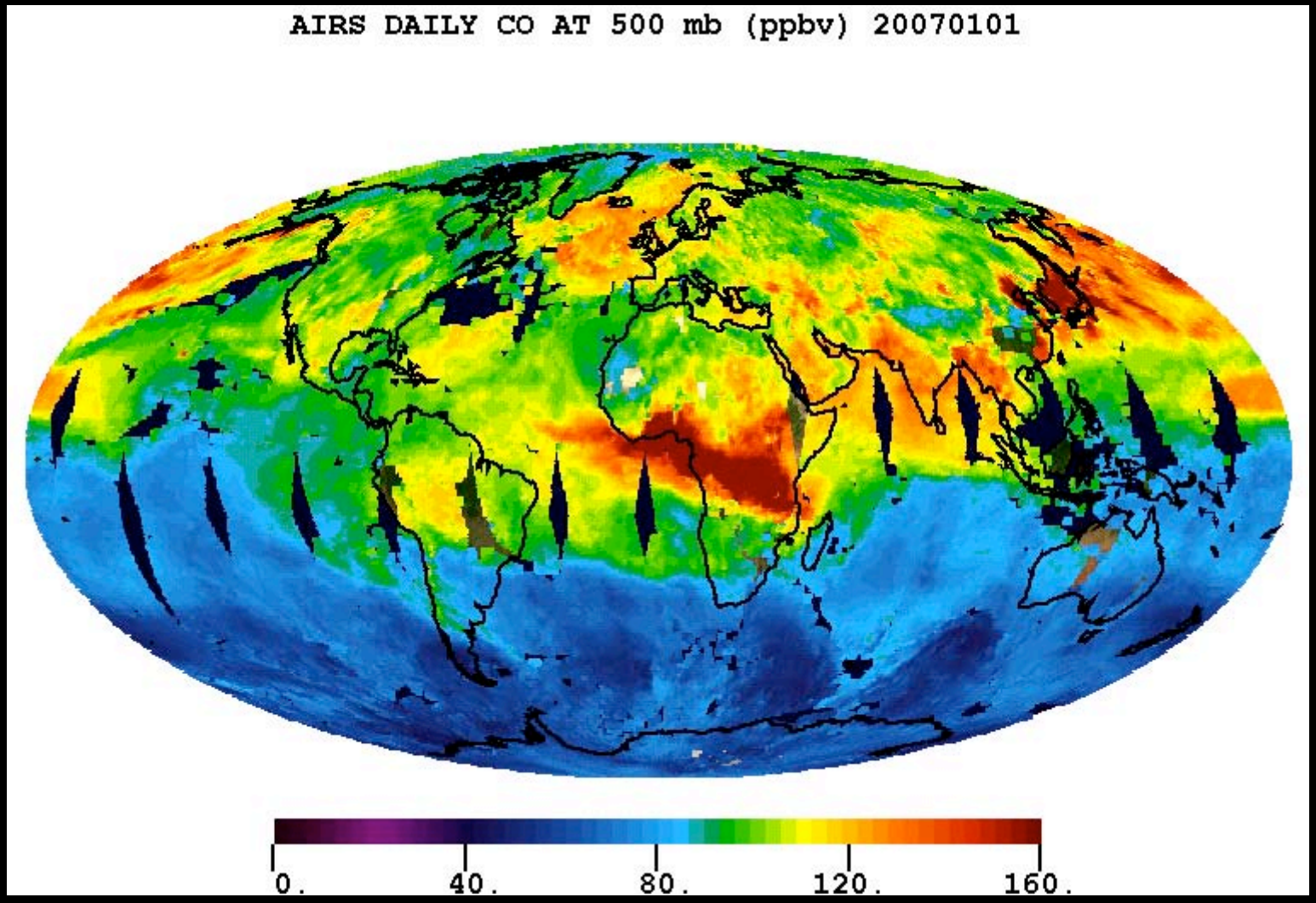
AIRS: Daily Global view



V5.0.14.0 CO standard product (movie from Ed Olsen, JPL)

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